Running Head: Distributed Technology Leadership Teams

Show Me the Leadership: The Impact of Distributed Technology Leadership Teams' Membership and Practices at Four Laptop Schools

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Distributed Leadership for Educational Technology: Leadership Teams at Four Middle Schools with Laptop Initiatives

Large investments by schools in the area of educational technology and its potential contributions to students' achievement have led to many studies of its integration and implementation in classrooms and schools. Often, too little access to technology is cited as a reason for its under-utilization by teachers and the subsequent lack of impact on student learning, Alternately, adequate access might be present but too little technology leadership or its associated results, such as technology support, are identified as barriers to effective technology use. Schools implementing laptop programs for students remove the barrier of adequate access to technology. The technical support structures that are required for laptop programs as well as the enormous monetary investments they require are likely to focus leaders' attention on implementation issues. Thus, schools with laptop programs can serve as opportunities to learn about what leaders must to do in situations that demand strong technology leadership. Rapid technical change and highly uneven distribution of expertise make technology leadership particularly challenging. In this paper I examine three case studies of technology leadership in schools with laptop programs to relate how resources and leadership interact in the context of technology implementations for learning and teaching.

Literature Review

At the majority of schools in the U.S., there is a team of people involved in leading the planning and support of technology uses. Nearly 80% of U.S. schools have a technology committee and technology support is, on average, provided by a team of two to three people (Ronnkvist, Dexter & Anderson, 2000). Team members typically include the principal and a technology coordinator, and nearly half the time (47%) the additional others included teachers.

Principals' involvement with technology responsibilities at the school---establishing a technology committee and budget, personally using technology, spending time on and setting aside money for technology planning---positively influenced teachers' and students' classroom uses of technology, more so than technology infrastructure or expenditures (Anderson & Dexter, 2005). Technology coordinators focused on instructional support issues can establish direction for and exert influence on teachers' technology-enhanced pedagogy (Dexter, Seashore & Anderson, 2003). Teachers who assist the technology coordinator or serve as experts to or even collaborators with their peers nurture a sense of professional community at the school (Dexter, Seashore & Anderson, 2002).

To achieve the best uses of educational technology in support of learning at a school it is likely its teachers will need opportunities and support for learning. Research shows that this is a significant challenge; high-quality technology support contexts are found in less than 15% of US schools (Ronnkvist, Dexter & Anderson, 2000), but when present supports teachers learning together about instructional uses of technology (Dexter, Anderson & Becker, 1999; Dexter, Seashore & Anderson, 2002).

While this research establishes it is a team of people, probably including the principal, technology coordinator, and teachers, who will carry out technology leadership at a school and that such leadership will need to attend to the purpose of the technology and its access and support, there is little knowledge of how these leadership functions and interactions should be

shared and coordinated among the technology leaders. That is, who does what in such a way that teaching and learning is supported by the presence of technology?

There is increasing interest in how groups of individuals might work together in a school to lead a common goal. Chrispeels has referred to this phenomenon as "shared leadership" (2004); others have described groups of professionals working together as "learning communities" (DuFour & Eaker, 1998). Spillane and colleagues (2004) have used the phrase "distributed leadership," to capture how leadership practices take place in "the interactions between leaders, followers, and their situation" (Spillane, 2005).

With its emphasis on the "situational distribution of task-enactment," distributed leadership allows for the technology infrastructure itself to become a part of the conceptual model of technology leadership. That is, it captures how "human activity is distributed in the interactive web of actors, artifacts, and the situation" (Spillane, Halverson, & Diamond, 2001) and thus recognizes explicitly how the technology itself may define and construct the leadership practices. Halverson expands upon the concept of leadership practices, specifically directing attention to leadership "artifacts," defining them as "entities intentionally designed to interact with, aid or alter the practices of people; designed to shape or reform existing practices in the institutional context (Halverson, 2003; Halverson & Zoltners, 2001)."

While there has been considerable work on distributed leadership and practices in general, these conceptions need to be applied to technology leadership. Improved theoretical direction is needed on how leadership and resources optimally combine in utilizing technology to support learning and teaching goals. Refinement of the conceptual dimensions of technology leadership would help to address the challenge of optimally defining how technology leadership and resources interact. These case studies serve as one contribution towards that application.

Methods and Data

Each case's site visit involved a team of four researchers working at the school site for three days. These days were used for conducting interviews with the principal, one or more technology coordinators, other administrators relevant to the school's laptop program, four to six teachers, and several students in these teachers' classrooms. In addition, the researchers at each site observed one to three classrooms and created observation notes. All interviews were recorded and transcribed. Researchers also collected relevant site documents. The data sources are summarized in Table 1.

Table 1
Summary of Interviews and Observations

	Teachers Interviewed and Observed	Administrators and Tech. Leaders Interviewed	Students Interviewed
Fulton Middle School	3 individually interviewed and observed (Science /Math, Math, English), Teacher Focus Group	Superintendent, Director of Technology, Principal, Technology Coordinator	Student Focus Group
Lewis Middle School	6 individually interviewed and observed (Science/Math, Math Science /Math, Science /	Laptop Project Director , Director of Information Systems, Principal, Technical	Student Focus Group

	Math, Science, Humanities (Social Studies and English), Teacher Focus Group	Support Specialist, and school staff and Tech Core meetings observed	
Lincoln Middle school	3 individually interviewed and observed (Science, Math, English)	Assistant Superintendent of Secondary Instruction, Director of Technology. Principal, 7th Grade Vice-principal, Technology Support Specialist, and Technology Committee meetings observed	Student Focus Group
Jackson Middle School	4 individually interviewed and observed (English, Math, English/ Gifted and Talented, Science)	Assistant Superintendent of Secondary Instruction, Director of Technology, Principal, Library Media Specialist, Technology Support Specialist	Student Focus Group

All interview transcripts and documents were analyzed with a structured coding scheme that was derived from the conceptual framework for the study. This scheme contained seven main coding areas. The first was about the innovation or reform itself and is designed to capture information about the 1:1 computer to student program, the history and scope of that innovation, including its goals and origin, the curricular/subject areas involved and its instructional organization. This allowed us to compare programs on the basis of their purpose and intent to improve the quality of instruction. A second code area is about the school itself and allowed us to organize information about the site, including background information on and the demographics of the school and its community. With this code we also tagged pertinent information about the school culture, its leadership, and any external relationships the school established to aid their technology implementation. This group of codes allowed us to capture relevant meso-level information about the school's setting and how together they helped to create a favorable context for the classroom uses of technology.

Another set of codes focused on the technology and the technology support present at the site. These codes supported our analysis of the vision for technology and the specifics of what the site has put into place, how it is kept working, and how teachers are prepared for its use. The next two sets of codes focused on students and teachers and their roles, practices, and outcomes. Together, these codes support the description and analysis of the classroom-based teaching and learning with technology. The final two sets of codes allow us to capture the elements of the site that contribute to the sustainability and transferability of its innovation. We differentiated between elements of the innovation itself, the classroom, school, and district components. These two codes were often used in conjunction with other codes.

The author coded all of the interviews from the schools reported upon here. Codes were assigned to sections of transcripts with the qualitative analysis program NUD*IST NVIVO. This program allows any length of the segment of text to be coded with as many codes as the analyst

sees fit to apply. After all coding was complete the NVIVO program was used to gather all text segments from that site's transcripts into a report for each code. These reports were then analyzed to determine the main points and themes within each code area. The points from the codes "about the school", and "technology and technology leadership" provide the main basis for the findings presented in this paper.

In addition to the qualitative data collected, we asked all teachers at the school sites to complete a 23-item survey asking them about their uses of the laptops, the technology leadership and support environment at the school, and the teachers' sense of professional community about technology use. Descriptive statistical analyses on these survey data were carried out using SPSS to determine the extent to which data recorded in observations and interviews generalized to the individual school site. Three open-ended questions are reported upon here.

The first asked for teachers' perceptions of who serves as technology leaders at the school; teachers had four blank lines on which to list the name and title of the technology leaders in their work environment and were to check all the technology-related roles fulfilled by each person they listed: leading professional development, providing technology support, serving as a expert on some aspect of educational technology aspect, assisting in working out instructional uses of educational technology, or other, which they were asked to describe. While the survey instructions indicated that respondents could add more names on the blank backside, no one did at any of the four schools.

A second open-ended question asked the teachers if they thought that the efforts of the technology leaders were adequately coordinated to collectively accomplish the most possible with the resources at hand and a third inquired whether or not they were able to give input to the technology leaders at their school about the direction and scope of the school's computer uses and initiatives and if so, how. For both questions, the answers were first analyzed holistically to categorize them as yes or no responses and then for themes in the explanatory statements.

Sample of Schools

Only four of the five schools in the study are reported upon in this paper. No survey data were returned from the fifth school. All four schools had students in the sixth, seventh and eighth grades; we focused our interviews and observations upon teachers of those grades. The three sites varied as to their location and the socioeconomic and racial make up of their student bodies. Demographic information about the four sites analyzed in this paper is provided in Table 2.

Table 2
Demographic Information for Grades 6-8 Middle School Sites

School Name*	Enrollment	District Type	Percentage Poverty[a]	Percentage Minority[b]
Fulton Middle School	1,017	Small Town	47.15	24
Lewis Middle School	890	Suburban	62.3	76.3
Lincoln Middle School	972	Urban	59.67	87.2
Jackson Middle School	551	Urban	21.9	54.7

[a] Free and reduced lunch percentage
[b] African American, Hispanic, Asian, Pacific Islander, American Indian, Filipino
*School names are pseudonyms.

Each of the schools varied in their stated purpose for implementing a ubiquitous computing program. Fulton's official purpose was focused on providing computer access to students. At there other three there was a clear instructional purpose given as their rationale. Lewis went with a thin client model of computing (network PCs lacking local diskette or CD-ROM storage devices that run off of centrally located and maintained servers), which reduced hardware and made high-quality technical support sustainable. Originally these were desktop machines that provided a 2:1 student to computer ratio in the classroom. A pilot program to provide tablet thin clients to about half of the sixth grade students began in the 2004-05 academic year. At Fulton the district purchased laptops that were then made available to students at school through carts their teachers would check out and roll into class. While checked out, the teachers could provide 1:1 access for students. In Jackson and Lincoln middle schools students participating in the laptop program all had one laptop assigned to then for the school year. A summary of the four schools' purposes for their laptop program, their distribution processes, and their resulting student to computer ratios are shown in Table 3.

Table 3
Computer Programs' Purpose, Placement, and Student to Computer Ratio

School Name	Purpose of Computer Program	Computer Placement & Student to Computer Ratio
Fulton	Instant access anywhere for any student at any time.	Laptops are placed in carts that reside in the English teachers' classrooms; teachers can check them out. The ratio is nearly 2:1, but when the carts are checked out to classrooms it is 1:1 access.
Lewis	Raise student achievement in reading and math, and support student inquiry.	Entire school has 2:1 ratio with desktop thin clients. There is a 1:1 tablet thin client pilot program for about half of the students in the sixth grade.
Lincoln & Jackson	"Enhance the curriculum of each core class" to increase student academic performance and to provide students' with equitable access to technology and technology skills in preparation for the workplace.	**Lincoln**: Team of 100 students within 6th, 7th and 8th grade **Jackson**: All 7th and 8th grade students

School Technology Leadership Portraits

Fulton Middle School

At Fulton Middle School technology leadership is distributed across a number of staff at the district and school levels, including the district's superintendent and director of technology and the school's principal and one of its two technology coordinators.

The need for technology leadership at the district level is mainly technical in nature, as reflected in the superintendent's description of the main goal of its Laptop Project as "instant access anywhere for any student at any time."

The leadership style of the superintendent has set the tone for the interactions between her and the technology director. In describing the superintendent's work style, the technology director said, "She just says 'We're going to do this. Implement it.' She does that quite frequently." The superintendent laughed and said she was inclined to direct staff members to "Here, make it happen. Come back to me when you've got it done," and later claimed that "I'm not a process person, I'm a product person." The technology director has held that position from the outset of the laptop initiative in 1998, and since the current superintendent was hired in 2001, their mutual work has been concerned mostly with issues of access and infrastructure. In 2001 a budget shortage forced them to consolidate the laptops into carts, instead of checking them out to students; the following year they initiated a wireless network across the entire district. Their leadership efforts to increase teacher and student uses of technology have included establishing that the required state tests be taken online and requiring teachers to use email, and more recently, the superintendent has asked all teachers to establish their own web page. In a joint interview, the two of them agreed that this was perhaps too big a stretch considering where teachers currently were in their technology use, but that asking for bold steps was characteristic of the superintendent.

To help carry out the superintendent's directives, the director of technology has two colleagues who offer some technology integration classes for teachers and a handful of support staff who administer the network and circulate to schools to provide technical support. The director's technology leadership interactions with Fulton Middle School are mostly with the school's technology coordinators. She meets with the all of the district's technology coordinators once a month to prepare them to help teachers at their respective schools following a train-the-trainer model. One of the middle school's technology coordinators reported that these meetings were very helpful and that she was able to get necessary technical information and questions answered, but that otherwise she didn't communicate with the district technology office because "I know they're busy, and unless I have a major problem that we can't solve here, I try not to bother her."

The technology leaders at Fulton Middle School follow very closely the direction from the district's technology leadership. The school's technology leaders are two full-time teachers who are paid an extra stipend to serve as technology coordinators, troubleshoot computers, and aid teachers with other technical support they require. While the school's organization would allow individual teachers to come forward as technology leaders and share their expertise, as of the fourth month in the school year (at the time of our visit), that had not happened. Although the laptop program's goals center on student achievement, students and their parents were not otherwise involved in the technology leadership practices.

The school's principal described herself as involved with technology leadership to the extent that she meets regularly with the technology coordinators, but she said she is not actively pushing for technology use by the teachers. This was a conscious decision on her part, as she felt it was not fair to push teachers to use technology when she could not provide adequate support and training for them to do so. Furthermore, she felt that her staff, only a few months into their first year together as a result of the consolidation of two middle schools, had not yet coalesced enough for her to successfully put technology integration demands upon them: "I have to establish the culture in the building before I can start establishing norms . . . and so, honestly,

this year technology is taking a back seat to that." She explained that at her former school she did "push the use of technology and to show them how great it is," but in the face of the high levels of teacher frustration about the technology getting set up and running that year, she had definitely backed off. She reported that she did meet regularly with the school's two technology coordinators, whom she complimented as doing a great job under the present circumstances, but that she didn't expect to increase the scope of her technology leadership practices that school year.

When asked in a survey to list the technology leaders in their work environment and to check all the technology-related roles that each fulfilled, 26 teachers responded listing ten different names. Among these were not only the two technology coordinators and the district director of technology, but also the assistant principal and six teachers. The role that teachers most often saw the technology coordinators as filling was providing technical support, with 33 mentions between the two of them, followed by providing instructional support, although this function received only about one-third as many mentions as providing technical support. Serving as an expert and assisting teachers with instructional uses of technology each received 15 mentions.

Teachers reported far fewer technology leadership functions being fulfilled by administrators and classroom teacher. The assistant principal was mentioned by five different respondents and mentioned several times in each of the four functions. The district director of technology was mentioned by a couple of respondents. Six classroom teachers were mentioned as leaders by a handful of their peers, although one respondent alone accounted for four of these names. Both of the two other teachers named were identified by a couple of their peers as providing technical support, serving as an expert, and assisting with instructional uses. In addition, respondents wrote in other responses such as sharing ideas and being an example of a frequent technology user. (See Table 4.)

Table 4
Number of Mentions of Technology Leadership Roles Fulfilled, by Job Title

	a) Lead prof. dev.	b) Provide tech. support	c) Serve as expert	d) Assist with integration
2 School Technical Coordinators	11	33	15	15
1 School Administrator: Assistant Principal	4	3	4	3
1 District Administrator	1	1	1	
6 Classroom Teachers	1	3	3	5

Note. n=26

Where asked if they thought that the efforts of the technology leaders were adequately coordinated to collectively accomplish the most possible with the resources at hand 17 teachers responded to this question; 11 felt that the technology leaders' efforts were coordinated for maximum effectiveness and 4 did not. The other two responses noted that the technology leaders had only technical responsibilities, implying there were not too many different sorts of efforts to coordinate. Nearly all of the respondents mentioned the limited amount of time that the technology leaders had available to dedicate to technology. Most of the teachers who agreed that the work was coordinated did so with the caveat that the two technology coordinators were also full-time teachers doing the best that they could. The teachers who did not agree that the technology leaders' work was coordinated for maximum effect said that they had too little time

to spend on technology matters and that too little information about technology and related procedures were communicated to the school's staff.

Thirteen teachers responded to the question about providing input to the school's technology leaders, 5 agreeing that they could give input and 4 teachers indicating they did not feel this was the case. Another four wrote that they didn't see the technology coordinators' roles as structured to take in teachers' ideas because they were so focused on technical issues. The mechanisms for giving input mentioned by teachers were forms for reporting technical need, and the coordinators' being accessible between classes, at meetings, or through email. Teachers who disagreed about being able to provide input simply said that they were not asked for input.

Lewis Middle School

A number of people at Lewis Middle School serve as leaders for the school's tablet and desktop thin client initiatives. These school technology leaders work closely and collaboratively with the district's technology leaders, who set the overall tone and direction for the district's technology infrastructure and its uses. The thin client approach at this school originated as a part of the district-wide initiative to create a sustainable, reliable computer network so as to use computers both to support student achievement of basic skills and to enrich student inquiry. The innovative thin client set-up and the range of expected classroom uses of technology creates a need for very strong technical and instructional leadership practices.

The district's technical leadership is spearheaded by the director of information systems, its instructional leadership by the ClassConnect director. These two district directors report that they frequently engage other administrators in discussions and planning for educational technology in the district. The district leaders connect at the school level with a group of technology leaders called the tech core team. At Lewis Middle School, the tech core includes the principal, assistant principal, and four classroom teachers.

Parents are involved in the technology leadership interactions at the school in that any can take part in the ClassConnect Home Connection program, which combines for one low cost per month an Internet connection and a thin client terminal that can access the school's network. Parents can use that to check the school bulletin, their child's grades, attendance information, homework assignments, and teachers' comments. Students contribute to technology leadership interactions in that they can volunteer to be a part of the one-to-one tablet thin client program or can ask to opt out of it at any time. It was also the characteristics of these middle school children that drove the design of the tablet—its rugged rubber case, the slot on its bag where students can insert a nametag and personalize it, and its light weight. Providing students and parents with access to the school network from home drives the whole Home Connection portion of the ClassConnect initiative.

The interactions between the director of information systems and the director of ClassConnect illustrate how the technology leadership interactions in the district are constantly weaving together technical and instructional considerations. The two directors requested to be interviewed together and alternated answering questions in an easy-going, comfortable manner that illustrated their close working relationship. They frequently added to the other's response, and several times looked at each other before answering a question and asked "Do you want to go first, or should I?" Their offices are next to one another, and they said that they frequently call out questions to one another across the vestibule that separates them and regularly use instant messaging to ask each other quick questions. The information systems director is continually designing new directions for hardware, software, and network infrastructure, which he describes

in terms of what the district is trying to achieve to support instruction, engage students in learning, and foster parent involvement. The principal of the middle school also reported that he saw the technical innovations and support they received from the district office as being related to instructional goals and teachers' feedback on what was working and what was still needed and evolving in what he described as a R & D format.

The district-level technology leadership also actively involves other district and building administrators because, as the ClassConnect director observed, "Technology is not a discussion item on its own. It is incorporated. . . . If you're talking about language arts adoption, well, then the use of technology is just a natural to talk about." The two directors described how they have consciously cultivated the involvement and support of the superintendent, top-level district administrators, the school board, and the school principals since the beginning, when their support was necessary to obtain grant funding for the ClassConnect initiative. For example, the directors had recently organized a school and classroom walkthrough, or "refresher" as they called it, in which district administrators and principals from all eight schools visited classrooms at each grade level in which notable technology-supported teaching and learning was taking place. The directors said that the two of them plus the director of educational services do walkthroughs of classrooms on a regular basis so they can get a clear idea and feedback about how technology is being used to support instruction.

When ClassConnect began, the two directors created a staff development model that involved teachers strategically so as to aid the development and spread of technology throughout the district. Each year of that 5-year grant, they trained 20% of the district's staff, drawing in teachers with varying levels of technology skills from all of the district's eight schools. The entire sixth grade at Lewis Middle School participated that first year. Gradually, over the next 4 years, teachers with more experience continued to spread throughout the district and could help teachers with less experience. As the directors were able to identify which teachers were most enthusiastic and risk-taking with technology and it became apparent that a thin client model was a way to increase computer access in classrooms without sacrificing excellent technical support, they implemented pilot thin client programs in a handful of teachers' classrooms. This approach of piloting new initiatives with the most willing teachers has been repeated with tablet computers, then tablet thin clients, and then particular software programs. Each time, the teachers participating in the pilot were key partners with the district technology directors and the school's principal in figuring out how the hardware, software, and even the room's configuration could be best used to support effective technology integration.

Within each school in the district is a group of technology leaders called the tech core who serve as the school's link to the district's technology leadership. These site technology boards include the school's principal and vice-principal and three to five full-time classroom teachers. At Lewis Middle School, four teachers are members of the tech core, three of whom have been school leaders in the integration of technology since 1998. As a part of their responsibilities, these teachers also occasionally offer classes to other teachers after school, for which they are paid a stipend.

We observed the tech core team's interactions at two meetings. At the first, the director of information systems led a discussion with the district's two middle school tech core teams on how to handle the roll-out of the middle school students' access to email. They all looked at the written policy statement on email and decided it was fine. The discussion was about when students would use email and how it might disrupt class. Various opinions were offered: that email shouldn't be used at all in class; that is was less disruptive than note passing and could be

dealt with similarly; and that it was no different than teachers not totally paying attention in a staff meeting. The director of information systems quoted a technology expert who had given a district-wide presentation at the start of the school year, saying that "today's digital kids can easily multi-task." The director steered the group back to the focus of the meeting and offered technical methods that could address their concerns. For example, he explained how a teacher could see any student's sent or received email, and one teacher then spoke up to describe how she'd already used that viewing capability to review the emails of one girl who had not been following the email guidelines and was able to clear up the problem.

Another meeting at which the tech core teacher leaders played a role was a school staff meeting in which the entire agenda concerned technology and included the email roll-out and the use of the drill-and-practice program SuccessMaker and its reports. The tech core team members led the discussion on these topics, and then the teachers broke up by subject area to discuss classroom implementation. In leading the email discussion part of the meeting, the tech core members drew upon the written materials, anecdotes, and discussion from the tech core meeting held two days earlier, but also made a point of adding tips about the classroom management of student email use. The meeting illustrated both how the rationale for and flow of technology information was influenced by the district's leaders and how the tech core teachers' classroom experiences with email were leveraged to implement good technology practices more widely.

The district technology leaders acknowledged that as the district moved into its eighth year of Project ClassConnect, their leadership practices had shifted to stating more directly their technology configuration and use expectations for classrooms and teachers. They explained that this adjustment in their leadership approach occurred largely because of parent input, notably parents' questions at meetings and in conversations parents about why their children were using technology so infrequently or weren't using particular applications at all. An example given by the director of information systems took place at a Back-to-School Night, where a parent who had bought into the Home Connection program reported that for three years in a row his child's teachers three had not set up class information, assignments, or processes that took advantage of its possibilities. That was an epiphany for the directors, which was further bolstered by a critical mass of teachers who felt all their colleagues should be incorporating certain technology practices into their teaching. One teacher interviewed at Lewis Middle School agreed that there had been a shift to a more directive style by the directors, which she felt removed some degree of teacher autonomy.

Twenty-seven of the teachers' responded to the question asking them about the technology leaders in their work environment and to check all the technology-related roles that each fulfilled: Ten different names were listed, of which four were the tech core teachers. The full-time technical support specialist was also listed, as were two district administrators. The remaining three names were additional teachers. All but the two district administrators were staff at the school. The teachers mentioned the tech core members primarily as serving as experts and providing instructional support for using technology, although they also often identified them as providing technical support or leading professional development for technology. (See Table 5.)

Teachers mentioned far fewer technology leadership functions being fulfilled by administrators or by other classroom teachers. The district administrators were each mentioned as providing technical support and expert advice a couple of times each. One teacher wrote that the ClassConnect director "runs the whole show," and another wrote that the director of information systems "oversees and creates 1:1." Teachers mentioned receiving assistance from

their peers with each of the functions, especially serving as an expert and providing help in working out instructional uses of technology.

Table 5
Number of Mentions of Technology Leadership Roles Fulfilled, by Job Title

	a) Lead Prof. Dev.	b) Provide Tech. Support	c) Serve as Expert	d) Assist with Integration
4 School Technology Core Teachers	29	30	42	43
1 School Technical Support Staff	-	8	1	-
2 District Administrators	1	2	2	-
2 Classroom Teachers	1	3	4	5

Note. n=27

When asked if they thought that the efforts of the technology leaders were adequately coordinated to collectively accomplish the most possible with the resources at hand, there were 21 teachers responded to this question. In all, 12 felt that the technology leaders' efforts were coordinated for maximum effectiveness, and 7 did not. In addition, two individuals wrote noted that duties seemed to be split up rather than coordinated among technology leaders. Those teachers who saw the leaders' work as coordinated often mentioned the many hours and hard work that the tech core teachers put in and that information is regularly disseminated and shared. Several teachers attributed their belief that leaders' efforts were not coordinated for maximum effect to their own sense of not being sure how they were supposed to be using technology in their classroom.

Of the 18 teachers who responded to the question about whether they were able to have input to the school's technology leaders, two thirds said yes. Those teachers reported that they were able to give input through their team leaders, the tech core members, and staff meetings, as well as being able to informally seek out technology leaders to give them ideas or feedback. Three of the teachers who felt they could not give input responded that they thought that district office decided on technology issues, that contrary opinions were not welcomed, and that technology use was mandated.

Lincoln Middle School

Lincoln Middle School is in the same district as Jackson Middle School. Thus, data reported by the district's assistant superintendent of secondary instruction and its director of technology applies to this site as well. These administrators, along with Lincoln's principal and its technology support specialist, indicated that technology leadership is distributed across a number of staff at the district and school levels.

Like at Jackson Middle School the laptop program at Lincoln Middle School has received strong leadership from the district level, starting with the community input on starting the laptops and continuing with the district leaders' commitment to involving stakeholders results in ongoing involvement from the community and a very active technology leadership group at the school level. The impetus for the laptop program came from input from community business leaders and others on a district advisory board for the district's technology planning. The superintendent decided to implement a laptop pilot in one school as a way to better prepare students by developing their technology proficiency and ability to use technology for research and other

schoolwork. When Lincoln Middle School was selected as the first pilot site, its administrators and teachers became a part of the technology leadership group.

At the district level, the administrators with instructional responsibilities and those with technology responsibilities work together closely. The director of technology said she collaborates on a regular basis with the director of library and media services, the director of professional development, and the specialists for the core content areas and electives who make up the district instructional team and who all report to the assistant superintendent of schools. The assistant superintendent was involved in the laptop program from the beginning as a key representative of the superintendent who is acknowledged as the catalyst for the laptop initiative. At the time of our visit, that superintendent had recently left the district and the new superintendent of schools was engaging in meetings with community members about what they felt was important for the district's vision and direction. The assistant superintendent was optimistic that the community's support for virtual learning throughout the district and the community would come through, and thereby convince the new superintendent to maintain the district's momentum with technology: "I am very hopeful that this will emerge again. It really had a very strong level of support."

Within Lincoln Middle School, the technology leadership team includes administrators and staff members who bear primary responsibility for technology and instruction. The principal is involved and is joined by the assistant principal for the seventh grade, whose extra responsibilities for the laptop program at the school earns him the title of technology principal. The school also has one full-time and one part-time technology support specialist, who together provide technical support and keep the school's servers running. The librarian's involvement in technology leadership is to provide professional development opportunities for the teachers. One teacher from each of the sixth, seventh, and eighth grade four-person laptop teams serves as a representative on the technology team for the laptop initiative. In addition, two retired teachers have worked part time on specific tasks related to the laptop initiative, such as creating a *Technology Handbook for Laptops* to distribute to teachers, students, and their parents and supporting the teachers in using the online textbooks used in the curriculum.

The assistant superintendent and director of technology both characterized their interactions with district-level technology leaders as cooperative and collaborative and attributed this to the fact that the majority of them had worked together for nearly 30 years. The assistant superintendent also noted that the instructional background of many of the technology staff members had helped to create a working environment where they worked as a team to support their technology goals:

> It's not something that you can replicate, but so many of us have been in [technology] enhancement for so long, that we already had this relationship. It wasn't like we brought in a bunch of new people because we have this technology. We already collaborated a lot, from the beginning, because some of them were already instructional people.

The two of them believed that technology staff members should focus not just on the hardware and technical issues, but rather work to help administrators with mainly curriculum and instruction responsibilities understand how technology could enhance their functions and goals. The assistant superintendent thought that this occurred in part through the technology director and her staff members' attending the instructional team's meetings:

> Our technology enhancement is very integrated. The technology people come to my instructional team meetings. . . . We all meet together. As a result of that, the technology

people have a greater understanding of some of the things that we're doing in the instruction area and are able to offer suggestions to us as to how we might better do that.

Thus the district technology leaders' interactions were frequent and focused on a shared goal of enhancing learning with technology.

The district and school technology leaders interact on a regular basis to discuss the laptop implementation. The district's director of technology and sometimes other district administrators attend monthly meetings with the school's administrators, technology staff, and teacher representatives. Their interactions are often focused on managerial issues---a discussion of what is working, what isn't, and what to do about it. One example of the topics discussed at these meetings is how to manage keeping a large number of laptops charged throughout the day when the classrooms don't have sufficient power outlets. Together the committee has also worked through how to manage the inventory process and how to communicate to parents about lost items and hold them financially responsible for replacing them. Their working together to find solutions to such problems allowed bringing district resources and knowledge to bear upon the situation and ensured that the context of the site and the teachers' perspectives were considered. One teacher from the committee explained that these meetings kept them "all on the same page from a managerial standpoint and an accountability standpoint" and provided a forum in which to advocate for additional resources or help: "If there was something I would want in the classroom, . . . it would obviously be restricted by the available resources, but I could put my idea out there and it could happen."

This same teacher reported that these monthly meetings sometimes also include sharing information on best practices, but that technology leaders usually dealt with instructional concerns through other kinds of interactions. The Lincoln teachers interviewed reported that they felt that the district technology leaders were available to help them whenever they needed assistance and that, often without the teachers' asking, they brought them new resources to try. A math teacher on a laptop team described the benefits of the district's math specialist's knowing how technology could support instruction. She had turned to the math specialist when she first started on the laptop team and reported that the specialist was "very helpful" and that "we get wonderful direction" from her. Departments at Lincoln Middle School have one teacher serve as an instructional leader who meets with all the district's instructional leaders and the specialist for their content area once a month. Not all instructional leaders are at schools with laptop programs, but nevertheless content-area specialists sometimes include information at these meetings about how to use technology to support instruction.

In a survey completed by 11 of the 12 teachers in this school's laptop initiative, respondents named the technology leaders in their work environment. Of the six names identified by teachers, two were the technology specialists, two were the media specialists, one was an administrator, and one was a district technology support staff member. (See Table 6.) The role that teachers most often saw the two technology specialists fulfilling was that of providing technology support, which received a total of 11 mentions. The other three categories were mentioned only two or three times for these two staff members. In contrast, the two media specialists received nine mentions for their expertise, six for assisting teachers in working out instructional uses of technology, and seven for providing technical support.

Teachers reported that administrators were fulfilling far fewer technology leadership functions. The assistant principal at the school was mentioned by one person for assisting with discipline when students used the Internet inappropriately. The district administrator who was assigned to help the laptop program teachers with the online textbooks was mentioned several

times for both serving as an expert and helping teachers work out their instructional uses of technology.

Table 6
Number of Mentions of Technology Leadership Roles Fulfilled, by Job Title

	a) Lead Prof. Dev.	b) Provide Tech. Support	c) Serve as Expert	d) Assist with Integration
2 Technology Support Specialists	3	11	2	2
2 Library Media Specialists	2	7	9	6
2 Administrators: 1 Assistant Principal & 1 District-based	0	2	3	3

Note: n=11

Eight of the eleven respondents answered regarding if they thought that the efforts of the technology leaders were coordinated to collectively accomplish as much as possible with the resources at hand. Five said that the technology leaders' efforts were coordinated for maximum effectiveness, and three wrote they were not sure. The teachers indicated that the structures that served to coordinate the leaders' work were the training sessions that were offered, the technology committee and its regular meetings, and the leaders' responding to problems as they were brought up. They mentioned no barriers to coordinated activity.

Five of the ten teachers who wrote a response to this question reported that they could give input to the school's technology leaders. The remaining responses indicated why the individual could not answer this question or the respondent's opinion about the laptop program overall. The five positive responses reported that teams have designated leaders to whom to give their input and that they felt that the leaders and fellow team members were open to hearing their ideas and suggestions.

Jackson Middle School

After the laptop program was up and running at Lincoln Middle School, Jackson Middle School was the second site in the district to get a laptop program. Like at Lincoln Middle School Jackson's laptop implementation has received strong guidance from the district level—including administrators with instructional responsibilities and those with technology responsibilities working together in a close collaborative manner and with active participation from the Assistant Superintendent. The district technology leaders' interactions were frequent and focused on the overall goal of enhancing learning with technology. District leaders press for ongoing involvement from the community and a very active technology leadership group at the school level.

Within Jackson Middle School, the technology leadership team includes administrators and staff members who are primarily responsible for technology and for instruction. The principal is involved in that she brings technology opportunities to the teachers and, as necessary, encourages them to take advantage of them, but the two library media specialists and their part-time assistant as well as a full-time technology support specialist carry out more specific duties, like technology professional development in both instructional and technical matters. The instructional leader (i.e., department chair) from each content area is a representative on the technology committee for the school, and two retired teachers have worked part-time on specific tasks related to the laptop initiative, such as creating a *Technology Handbook for Laptops* to

distribute to teachers, students, and their parents and supporting the teachers in using the online textbooks used in the curriculum.

The district and school technology leaders interact about implementation of the laptops at Jackson Middle School, but less frequently than at Lindsay. The director of technology and, as needed, other district administrators and the school technology committee members attend meetings at the school site when invited. Overall, Jackson Middle School is more autonomous in their implementation of the laptop program, which largely appears to be a function of the school culture. When district administrators do interact with school technology leaders their interactions are often about managerial issues---a discussion of what is working, what isn't, and what to do about it. The first year of the laptop program at Jackson Middle School this group met on a monthly basis; since then, these interactions were reduced to meeting about every two months or as needed. Sometimes the technology committee would call for a meeting of the full faculty (even though sixth graders do not have individual laptops, all teachers teach at least one eighth grade class) so that the staff could come to a consensus on managerial issues such as a procedure for keeping the laptops charged, how to collect the laptop fees paid by parents, and so forth.

The technology committee members are the technology leaders in the school. The principal described her technology leadership role as garnering opportunities for bringing technology into the school and presenting these choices to her staff, whom she described as "stellar." As an example, she described a chance that the school was offered to pilot a web portal system that worked with the school's electronic grading program to provide parents with access to their child's grades, attendance, homework assignments, and other activities. The principal wanted the school to try it and presented it to her staff members as an opportunity they just shouldn't turn down, considering the school's status as a technology innovator:

> We had to do some prodding to bring the whole seventh grade on this semester. And we had to present it as "This is where we are in our world of technology as Jackson magnet school. These are the expectations of our children. . . . Here are the expectations of the parents. How are we going to have this opportunity and not provide it?"

The principal said that once some element of the school's technology direction has been set, other technology leaders step in to work out the specifics with the teachers. She described how, as the building's overall leader, she relied a lot on email to communicate information and on her technology staff and instructional leaders to work out specific details with the teachers. One of the media specialists, during an interview with her and the principal, described the principal as having a strong ability to motivate her staff: "Talk about a motivator. . . . We joke about a deer being stuck in headlights!" They both described the staff as exceptional, a group of leaders and self-starters. Thus as technology leaders, the interactions of the media and technology support specialists' with teachers were mostly about making learning opportunities known to them or responding to their requests for information.

The instructional leaders' technology leadership interactions occurred mainly in the context of weekly department meetings, where they would either bring technology topics to the agenda or take input from teachers about technology and bring it to the school's technology committee. Several of the teachers interviewed reported that they didn't feel pressure to use the laptops in any particular way, or perhaps even at all, but rather that they were trusted to use their best pedagogical judgment. One math teacher shared that while she used the laptops as much as possible, the principal "has not given us any direction as far as how much the laptop is to be used. We decide on how we are going to utilize it as individuals in our classroom."

Surveys were completed by 25 of the 38 teaching staff. In them, where teachers were asked to list the name and title of such persons and asked to check all of the relevant responsibilities met by each, altogether the teachers listed eight names. (See Table 5.) Of these, four were of the school-level staff whose formal job responsibilities included technology support for teachers: the technology specialist, the two media specialists, and an assistant media specialist, three of whom are administrators in the district and one of whom is a teacher. The role that teachers most often mentioned being filled by these four technology support personnel was that of providing technical support, with 50 mentions. The second most common role was serving as an educational technology expert (46 mentions), followed closely by leading professional development and working out instructional uses of educational technology, with 42 and 41 mentions, respectively. Of these four individuals, the technology specialist was most frequently mentioned in each of these roles, followed closely by each of the two media specialists. (See Table 5.)

As would be expected, teachers reported far fewer technology leadership functions as being fulfilled by district-level administrators and teacher leaders than by the school technology support personnel. The three district staff who were cited were mentioned by one or two people each, with the respondent usually indicating one or two roles for each name. Altogether, the three district administrators received four mentions of serving as an expert, three for providing technical expertise, and two for providing assistance in instructional uses. One respondent mentioned one Jackson teacher's name and checked that this individual provided technical assistance, was an expert, and provided assistance in instructional uses. (See Table 7.)

Table 7
Number of Mentions of Technology Leadership Roles Fulfilled, by Job Title

	a) Lead Prof. Dev.	b) Provide Tech. Support	c) Serve as Expert	d) Assist with Integration
4 school-based: Technology Specialist, Media Specialists, and Assistant Media Specialist	42	50	46	41
3 District Administrators	0	3	4	2
1 Classroom Teacher	0	1	1	1

Note. n=25

Of the 25 teachers who returned the survey 18 answered the question asking if they thought the efforts of technology leaders were coordinated so as to collectively accomplish the most possible with the resources at hand. Of these, 16 indicated that the technology leaders' efforts were coordinated for maximum effectiveness, while only 2 said they were not adequately coordinated. Those who saw the work as coordinated cited as evidence that the leaders were always accessible and provided training opportunities to the teaching staff and that their needs were being met. The two negative responses added that teachers needed more training or follow-up and peer coaching to help them learn to use technology with students.

Of the 25 teachers surveyed, 14 responded to the question asking whether they had opportunities to provide input to the technology leaders, with 11 agreeing that they did. They reported that their input was asked for, that they felt heard when they gave suggestions, and that they felt they could speak up if they wanted to.

Discussion and Implications

The purpose of the laptop initiative in these case studies set the main direction for the technology leadership team at the school. This direction in turn drove what staff members were a part of the leadership team, the collective expertise and authority levels represented in the group, as well as the team's practices (e.g., the committees, meetings, and communication processes). Of consequence was the nature and degree of teachers' opportunities to shape the school's laptop program.

At Fulton Middle School the district leaders initiated their laptop program in terms of providing computer access to students, and did not include in their vision strong curricular or pedagogical components. The classroom teachers at the middle school are not involved in the technology leadership practices, such as membership on the technology committee; the principal's and two teachers who serve as technology coordinators' limited technology leadership interactions are focused mainly on technical support issues.

In contrast, the other three middle schools defined their purpose for technology in terms of student outcomes, which necessarily included curricular and instructional concerns and led to greater teacher involvement. Lewis Middle School's district technology leaders tightly coordinated their instructional and technical efforts to initiate the laptop effort at the school. The technology leadership interactions at Lewis Middle School focused on teaching and learning issues and four teachers were members of the site's technology leadership team. These teachers present to and lead professional development for their peers about technology uses and usually lead the staff meetings when technology topics are under consideration.

Jackson and Lindsay Middle Schools shared the same district-led instructional focus for their laptop initiatives. At each site there were teacher representatives on the technology committee. At both schools this was conceived as teachers serving as representatives for their peers taking part in the laptop program, at Lindsay via each grade level and at Jackson via the department chairs. These representatives were to serve as the conduits of information between the classroom teachers and the technology leadership team, whether through informal interaction or the regularly scheduled grade level or department meetings.

Thus, the degree to which there was an instructional emphasis in the vision for the laptop program influenced teachers' membership on the technology leadership team, and therefore whether or not teachers' voices were a part of the team's deliberations as decisions were made. Teacher membership on the team also then disperses knowledgeable teachers throughout the school that can provide other classroom teachers with direct information from the leadership team, as well as take their input.

At all four sites it was the classroom teachers' direct experiences with team members, largely via the team's technology leadership practices, that shaped their opinions of how coordinated the team's efforts were and their own opportunities to give input about technology at the school. Teachers named specific procedures and processes through which the team completed its work as evidence of coordinated effort and as their invitation to provide input. In addition, the teacher's personal level of understanding about the vision for the laptops influenced their opinion of the team's coordination; their personal level of agreement with the vision seemed to determine some teachers' opinions about whether or not their input was invited.

For example, at Fulton Middle School the classroom teachers reported that in the context of roles limited to technical support and given limited time the Technology Coordinators' work was coordinated and identified the technical support forms or email as their chance to give input to these individuals. At Lewis Middle School the bar for technology leadership was set much

higher. The Tech Core teachers were to provide instructional support and expertise and the hours they put in, the presentations they made, and the information they sent out were all cited as teachers as indicators of coordinated leadership efforts on their part. Jackson Middle School's teachers framed their opinions of leaders' coordinated efforts and opportunities for input in personal terms, citing that they felt listened to, and saw actions taken when they spoke up about something.

At all four schools when classroom teachers reported that their input was not solicited and that leadership teams' efforts were not coordinated they gave personal reasons such as not having a clear indication of what they should be doing with technology, or else not agreeing with the direction that had been set.

Thus, it appeared that teachers in this study looked for congruence between the stated scope of and purpose for the technology leaders' roles and the related practices in which these individuals engaged. How these practices "bump" directly into teachers generates their impressions of how well leaders are working together and taking teacher input. This congruence and these experiences seemingly contribute to these teachers' sense of understanding about the purposes of the laptops. To the degree that teachers' opinions of leaders' capabilities and efficiencies matter, these data suggest that technology leadership teams should manage their work and where teachers will interface with it so that teachers understand the vision for and purpose of the technology initiative.

The classroom teachers' direct experiences with the technology team members also shaped their sense of who was a technology leader or not. At each of the four school sites the teachers did not list the whole range of people involved in technology leadership as the school's technology leaders, but rather mostly the people in technology-specific roles who they most often saw and heard "doing" technology. At all four schools the district-level administrators initiated laptop programs and the school's administrators interacted regularly with the district office about technology. Yet, when asked who the school's technology leaders were the school and district administrators were rarely mentioned by teachers as being a part of the technology leadership team. In addition, a few teachers at each site mentioned a small number of other teachers who were not formally on the technology leadership team as leaders of technology.

For example, at Lewis Middle School the initial outreach to get schools informed and involved started at the district office. The two key district-level administrators led the technology efforts as a central initiative--with control of budgets and staff development offerings--but partnered with the school sites' principals in order to garner schools' involvement and support. They considered a new technology effort like their tablet laptops as a pilot program and sought feedback from teachers in order to shape the effort to fit the teaching and learning needs and make decisions about expanding the initiative beyond the pilot. These district-level administrators traveled regularly to the school site's technology or staff meetings and communicated regularly with the principal in order to stay informed. In effect, that there were school-level personnel on the technology leadership team was more the design of the district-level administrators, rather than vice versa. Yet, only two teachers at the school named the district-level administrators as technology leaders and no teachers listed the school-level administrators; a couple of teachers who were not on the Tech Core team were mentioned by a handful of their peers as technology leaders.

The laptop programs at Jackson and Lincoln Middle Schools were also initiated by district-level administrators, who interacted regularly with the school-level administrators about these programs and their implementation. Each month several district-level administrators would

attend Lincoln Middle School's technology team meetings, which were organized and led by the assistant principal of the school. Jackson Middle School's principal interacted regularly with district administrators and when asked they would attend the school's technology team meetings. Yet, at neither of these two schools did the teachers list the principals as technology leaders, and at Lincoln only one teacher listed his or her school's assistant principal. Just a few teachers at each school mentioned any district-level personnel as technology leaders and only at Jackson did one classroom teacher get mentioned as a technology leader.

At Fulton Middle School there was a slightly different pattern in that the school's assistant principal was named by five teachers—the most any site's school-level administrator received recognition as a technology leader. Although like at all of the other schools, the principal was not mentioned at all. Several classroom teachers and the district technology administrator also received mention.

Thus, it was mainly team members who have technology-specific titles and roles and who interacted with them directly that teachers identified as technology leaders, and presumably from whom they would be more likely to take input from and direction about the laptops' uses at the school. It appears that titles and /or team membership designations do matter in that they invest authority in and direct attention to technology leaders. In creating a new position, such as technology coordinator, this is easier to do. But when administrators and classroom teachers serve as technology leadership team members and it is desired that the other school staff members look to them for direction, these data suggest that adding a technology-specific title or designation and regularly communicating the team's membership may influence teachers' opinions of who the technology leaders are in a school. In that teachers did not name general leadership positions such as the principal as technology leaders, perhaps teachers feel that an individual must also demonstrate technology expertise in order to be considered a technology leader. This suggests that when principals wish to advance an initiative like technology integration in classrooms, they may need to develop expertise and not just hire it so that they can leverage their authority.

Conclusion

The cases presented here support the notion that technology leadership should be considered a school characteristic: It is distributed across a team of people that altogether provide technology expertise and decision making authority and who take responsibility for in setting direction, developing people, and making the organization work for educational technology. The cases illustrate Spillane's (2005) description of a recursive effect among the leaders, the situation, and the followers, and how leaders' practices are distributed across the social and the situational context. Because leadership practice matters and teachers' actions determine what aspects of an innovation get implemented or not in a classroom, it follows that teachers' understanding of who the technology leaders are and so from whom they look to get and give input about technology uses for teaching and learning also matters. Teachers most readily identify individuals in technology-specific roles as technology leaders, and base their opinions of the team's coordinated effort and interest in teachers' opinions off of their direct, personal experiences with these individuals. In these distributed leadership situations teachers' stance might be described as "show me the leadership." Distributed leadership increases the opportunities to provide more direct experiences with leaders, yet suggests a need for a specific design for the team's

membership and its practices so as to maximize the impact the team can make, since this effect is constructed teacher-by-teacher.

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