Leading the Learning:
Expertise and Technology Integration Support Staff

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Abstract

This study illustrates how support is not just a matter of consulting with teachers about their technology issues, but it is a matter of using one's expertise to provide technology and instruction ideas, recommendations, and help to the school as a whole. We argue that such support is a form of leadership because without such input, the school would flounder and lose direction in its technology-relevant programs. Discussing support as an aspect of leadership reminds us of how complex changes in schools require significant attention to details, and cannot just be obtained through visionary statements alone. Also, these cases suggest that successfully implementing a complex improvement effort warrants a team-based leadership approach.

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This paper focuses on the intersection of three topics that are central to the study of change in organizations, but which have different research histories: the role of leadership, the role of experts and expertise, and the nature and functioning of teams. In order to explore these topics, we draw on case studies that we have conducted in nine schools that were selected because of their exemplary integration of technology to support school improvement. The initial focus of the case studies was to define and develop portraits of the nature of exemplary technology integration, but as the case studies emerged, the three themes that we explore here emerged early and quite clearly.

In particular, we observed that in each of the sites one or more technology specialists played an important role in providing both support and subtle pressure for change. Support and pressure are, as Huberman and Miles (1992) observed, among the hallmarks of effective change leadership in schools. The technology specialists had various titles and positions, but no supervisory authority. In each case, teachers spontaneously attributed a key role to these individuals, suggesting that that their leadership for change is worth closer examination.

Such personnel are often characterized as support staff, which suggests a subordinate role, yet the majority of these technology integration support staff were a part of a team for technology leadership. Data from these case studies draw upon classroom observations, interviews, and site documents; from this we present how technology integration support staff members' actions were an essential aspect of technology leadership---which we consider as a function of the school. Specifically, it was through their expertise that they supported teacher and organizational learning and thereby exerted considerable influence on how technology was incorporated into the substantive core of teaching and learning at these school sites.

Research on Leadership

Research on leadership for school improvement tends to be highly position-focused. In particular, most research examines the role of the principal, and there has long been consensus in the literature (both educational and from other fields) that organizational leaders can make-or-break change efforts (Burns, 1978; Fullan and Stiegelauer, 1994; Hallinger & Heck, 2002; Nutt, 1986). In the 1990s, the image of "transformative educational leadership" was juxtaposed with "transactional leadership" that attended primarily to improving the daily operations of schools. The transformative leader was viewed as effective because he or she was able to set forth a clear vision and mission that would guide the school in new directions—a dramatic break with the expectation that principals were "middle level bureaucrats" whose role was to implement the expectations of their district officers.

In schools, the focus on positional leadership has been particularly evident in the effective schools research, ranging from early case studies that document the role of leaders in maintaining high standards in low-income schools, to the increasing string of international studies of a cross-section of schools (Teddlie & Reynolds, 2000). This image of leadership often focuses explicitly on the transformative character of individual action and vision. This image has been embedded in textbooks for training new principals (Reitzug, 1997), which portray a "principal-centric" view of change in schools.

More recently, the emerging literature emphasizes the indirect effects of leadership behavior rather than authoritative positional leadership. There are a variety of ways in which

more diffuse leadership effects can be examined. Spillane (2001), for example, argues that "distributed leadership" is a practice that involves cognitive engagement with the school's social and situational context, a perspective that is reflected in the work of others, not only in the US (Cascadden, 1998; Pounder, 1995; Spillane, Halverson & Diamond, 2001), but in other countries (Carter, 2002; Gronn, 2002; Harris, 2002). There is accumulating evidence that some forms of distributed leadership are associated with effective change and organizational performance (Kanthak, 1995; Pounder, 1995). Some research demonstrates that schools in which teachers have more influence over decisions that affect the school and students are more likely to have high levels of student achievement (Marks & Louis, 1997).

The increasing interest in teacher empowerment, participation, and distributed leadership has lead also to an interest in the effect of teams and team work in schools. School culture or climate is an important intervening variable that helps to account for the effects of leadership behavior on innovation and student achievement, and leadership behaviors are often associated with more-or-less positive relationships among both adults and children (Hoy, Hannum & Tschannen-Moran, 1998). Many have investigated the effects of school leadership on the teacher culture of the school, particularly on the propensity of teachers to engage in professional dialogue (Scribner, Cockrell, Cockrell, & Valentine, 1999) and to be open to innovation (Leithwood & Louis, 1998). Creating teacher teams, usually as a result of the initiative or support of the principal, is one strategy that has often been used to foster teacher leadership for innovation and improvement, but the results of such structural changes have been mixed. Formal teacher teams may have limited effects on student achievement (Supvitz, 2002), and may even undermine collaboration on a school-wide basis (Kruse & Louis, 1997). However, there is increasing evidence that well organized cross-functional or multi-skilled teams have positive effects on adaptive change and improvement (Bunderson& Sutcliffe, 2002; Edmonson, Bohmer & Pisano, 2001; Forrester, 2000; Leithwood, Steinback & Ryan, 1997).

In addition to research on the importance of leaders and teams in determining the outcomes of an improvement effort, there is also a significant line of research (again both in and out of schools) that suggests that in order to be effective leaders of improvement, people with any kind of designated authority—whether as formal leaders or members of teams with leadership responsibilities— must also be regarded as experts (Friedkin & Slater, 1994; Hornstein, Callahan, Fisch & Benedict, 1968) or, at least, intellectual leaders (Foster, 1989; Leithwood & Louis, 1998) if they are to be influential. The role of expertise in change has been studied more extensively outside of education, following French and Raven's well-known categorization of alternative "bases of power" (French & Raven, 1959). "Expert power" has been shown in numerous experimental and natural settings to have enormous influence over peers and subordinates. Warren's classic study of elementary schools showed, for example, that teachers were much more likely to conform to a principal's expectations when they perceived him as expert (Warren, 1968), while more recent studies of technological innovation in industry suggest that the involvement of experts and implementers in problem solving strongly facilitates a complex change process (Tyre & Hauptman, 1992).

In schools, internal expertise is often ignored due to professional norms (and a compensation structure) that presume a roughly equal distribution of knowledge and skills among teachers. Some writers presume that this is because teaching is a "semi profession" rather than a "real profession" based on specialized expert knowledge (Lortie, 1975). Other would argue, however, that knowledge about teaching is very complex because of the enormous variability of students, the multiplicity of objectives, and the imprecise research base and the

nature of expertise among a group is thus harder to define (Perrow, 1986). Whatever the reason, there is little research on the role of expertise or experts (other than the principal as expert) in promoting improvement in schools, although the notion of experts and school development is implicit is some writing on organizational learning (Leithwood & Louis, 1998).

Methods and data

The specification of criteria for site selection was a long process that involved extensive discourse with an Advisory Committee and consultants. The six criteria that were developed for selecting sites were as follows: (1) a majority of teachers at the public school had to be engaged in a school-wide reform or school improvement; (2) a majority of teachers had to be engaged in an innovative, technology-supported pedagogical practice; (3) the school had to be committed to meeting high content standards in core subjects; (4) the students should be drawn from diverse backgrounds including a number of low income students; (5) the reform effort and the innovative technology-supported teaching practices had to have potential for sustainability and transferability; and (6) there needed to be compelling evidence that the reform effort and the innovative technology-supported teaching practices had resulted in educationally significant outcomes or gains for the students involved.

The search for sites began by sending a solicitation letter to all 50 State technology directors. Another source of nominations came from directly contacting representatives of school reform programs and projects known to have a major technology component. Projects designated by the Secretary of Education's Expert Panel on Educational Technology were included. By the spring of 2001, nominations for 86 different school districts and approximately 110 schools had been received. The site selection process was arduous, and included input from a variety of sources. Many weeks were spent interviewing key personnel from candidate study sites, discussing each proposed study site with advisors, and examining countless documents from the schools. The 11 sites which best met the six criteria were selected for site visits and case study reports.

Each site visit included a team of two researchers working at the school site for 5 days. These 5 days were used for conducting interviews with the Principal, one or more technology coordinators, other administrators relevant to the technology reform program, 4–6 teachers, several students in these teachers' classrooms and several parents. In addition, at each site 2–4 classrooms were systematically observed by the researchers. All interviews were recorded and most are videotaped. The classroom observation periods were videotaped with one or two cameras.

Prior to every interview the prospective interviewee was informed of the nature of the questions, his or her right to avoid answering the questions, and the confidentiality procedures with which all of the data would be treated. The Principal and other staff were promised that neither they nor their school would be identified, unless they explicitly authorized us to use the names. After collecting the data and showing them their school's case report, all of the schools expect one gave us written permission to use their names in our reports. In this report all of the actual school names are used except for the school given the fictitious label "Mountain Middle School."

As soon as the site visit was completed, site documents were logged and filed for analysis and reference. The interviews were transcribed into document files. The text segments in these files were then coded according to a coding scheme. This scheme contained seven main coding areas. The first was about the innovation or reform itself and is designed to capture information

about the technology-supported school-wide innovation or improvement, the history and scope of the innovation, including its goals and origin, the curricular/subject areas involved and its instructional organization. This allowed a comparison of reforms on the basis of their purpose and intent to improve the quality of instruction. A second code area was about the school itself and allowed the organization of information about the site, including background information on and the demographics of the school and its community. With this code the pertinent information was also tagged about the school culture, its leadership, and any external relationships the school established to aid their technology implementation. This group of codes allowed the capture at a 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 the analysis of the vision for technology and the specifics of what the site has put into place and how it keeps it working and teachers 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. The elements of the innovation itself were differentiated between the classroom, school, and district components. These two codes were often used as a second additional code to some other pertinent information.

Each team of two researchers divided up the interviews to code; 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. The main points and themes for this paper were derived from analysis of the reports within the technology support and leadership and culture code areas. These reports were run in batches so coded segments from the teachers', support staff members' and the principals' interviews formed separate files, to aid the analysis of themes by role.

Background on The School and Technology Contexts

The nine sites presented here include four elementary schools, four middle schools, and one senior high school. The tenth school in the study was a magnet high school; its enrollment of 200 students meant that there were only 12 teachers on staff and no one in the role of technology integration support staff. The eleventh school in the study was a virtual school, and thus was so different a model that so for this topic was not appropriate for comparison with others presented here.

One middle school is quite large with over 1300 students; otherwise, the schools tend to be somewhat average or typical in size. Newsome Park is a magnet school and only about 6– years old. The remaining schools are older, more established schools. Four schools reside in sizable urban areas and five in suburban communities. (See Table 1.)

There is considerable variation in the racial diversity and family poverty (as measured by the percent of students receiving free or reduced-price lunch) of the schools. Three schools have relatively little diversity and poverty: Frontier, Mantua, and Mountain. Six schools have 60% racial minority or greater and very high poverty levels. (See Table 1.)

Table 1
Demographic Information for School Sites

School Name	Grades Served	Enroll-ment	Type of Location	Percent Minority	Percent Poverty*
Newsome Park	K-5	768	Urban	60%	60%
Mantua	K-6	618	Suburban	25	7
Frontier	K-5	891	Suburban	11	35
Canutillo	K-6	665	Suburban	95	100
Mott Hall	4-8	450	Urban	95	80
Mountain[1]	6-8	1,338	Suburban	12	7
Lemon Grove	6-8	800	Suburban	65	75
Jennings	7-8	500	Urban	95	80
Emerson	9-12	1,343	Urban	90	92

* As measured by free or reduced lunch.

All of the schools had a *classroom-based* student to computer ratio that met or exceeded the national average (which also counts computers located in labs). Two sites had a 2:1 ratio and two sites had a 1:1 ratio in their classrooms. For the six schools where the classroom-based computer-student ratio was higher, 5:1 and 4:1, the arrangement of the technology in the school was somewhat flexible so additional computers could be brought into the class or made available to the students (See table 2).

In addition, most if not all of the computers in these new schools were networked, so file sharing and Internet access was available. The teachers all had some sort of large screen display capability available for them to display a computer screen's content; digital cameras, scanners, and printers were also available to the teachers. Together these features added functionality to the use of their computers. This high level of access is significant because it meant that technology was usually readily available as a tool to the teachers and students. It also meant that teachers' work to integrate technology generally could focus on curriculum and pedagogical concerns without worrying about scheduling conflicts or complicated logistics necessary to rotate all of the students through a limited number of computer stations.

Table 2
Summary of Innovative Technology-Supported Reforms and Student to Computer Ratio

School	Improvement Effort Underway for Each School	Student to computer ratio
Newsome Park	Project based learning using wireless laptops	5:1
Mantua	Basic school powered by technology	1:1
Frontier	Technology to support student project work and student achievement data analysis	5:1
Canutillo	Constructivist learning environments, supported by technology	5:1

[1] School name is fictitious for confidentiality purposes.

Mott Hall	Laptop one-on-one program for all students, and increased use of project-based learning	1:1
Mountain	Technology to support standards-based high student achievement	4:1
Lemon Grove	Thin clients supporting academic performance	2:1
Jennings	Inquiry teaching supported by technology	2:1
Emerson	Whole language supported by technology	5:1

The technical support---troubleshooting, repair, and maintenance---was deemed excellent by the teachers at eight of the nine schools. Only at Mott Hall, which had a program of a laptop per student, did we hear teachers complain about the reliability of their equipment, saying that the laptop repair program was slow and left students without a computer for too long. Several districts explicitly stated that they made providing excellent technical support a very high priority, explaining that without this, teachers would likely be unwilling to plan for the use of technology. For example, the Lemon Grove district technology director recognized that technology support was an essential condition for technology use:

> And I tell you, to make it work in these rooms, it has to work all the time. To make teachers adopt it, and accept it, it's got to work, and they have to trust that it's going to work. And their trust is going to take a long time to build.

Other schools provided reliable technical support through a combination of on-site and district, or other outside, support staff. In sum, these schools varied in the size and location, but the majority had mostly non-white and high poverty populations. The sites were very similar in that they had a relatively high level of access to technology for students and staff, and had some person(s) serving in a role that provided technology integration support to teachers.

Findings

Designated Leadership Teams

The technology activities at these sites were most often coordinated and led by a team of people. At the school level, the team members included the principal, instruction-technology support staff member(s), and some teachers. For the two district led initiatives the teams included district administrators, the instruction-technology staff members, and some representative teachers. Below, these teams are described briefly to give a sense of the range of input from different role representatives.

Newsome Park Elementary pulled together grade level representatives, the technology teachers, and the administrators into a leadership team to write their professional development grant. Through this work the school adopted a particular three-stage approach to project-based learning; this led to their planning how technology could support this pedagogy.

Mantua Elementary School had committed to the Boyer Basic School movement when they received money for technology as compensation for a nearby oil spill. Their whole staff's involvement in implementing the Basic School philosophy was extended to the technology plan they had to create to receive the compensatory funds.

At Canutillo Elementary School the principal had created a technology leadership team, comprised of the technical support person at the school and teachers representing each of the grade levels.

Emerson High School and Mountain Middle School's additional funds for technology came from their district, which did require them to explicitly plan for how technology would support student achievement. At Mountain Middle a building council, comprised of teachers, administrators, classified staff, and parents, met weekly to plan how to work towards improving students' attainment of standards; technology was considered in that discussion as one of many tools to help differentiate instruction so all students can meet the curriculum standards.

Lemon Grove Middle and Jennings Junior were the two schools in our sample whose technology integration and implementation efforts were led by the school district. They were similar in that the purpose for technology, the hardware and software, the technical support provided, and the integration training all were planned for and provided by the district office. Lemon Grove District had 100% of its teachers participate in the training offered at the district level, and so any staff member was able to represent a technology viewpoint at meetings and on committees; some teachers took on an instructional support role informally, by presenting to peers at staff meetings. At Jennings Junior, the training was offered to anyone and was framed in terms of supporting inquiry-based instruction, which they emphasized would improve students' performance on state tests. Teachers were encouraged and volunteered to sign up in teams to attend the unpaid training, which was a condition---but not a guarantee of---receiving a technology classroom (with 2:1 student to computer access). This resulted in a shared goal of using technology to support inquiry among the teachers in the technology classrooms (who had completed the training), but thus the participating did not represent the entire school. The district technology team was made up of the superintendent, technology director, the technical support staff and the technology integration specialists.

Technology Integration Support Staffing Models

There were three basic models of instruction-technology support staffing employed within these schools. These staffing models seemed to have emerged from the school's historical traditions and constraints, particularly with regard to funding for technology and technology support. All sites had access to experienced technology-using teachers as instruction-technology support staff; this was in addition to the technical support described in the previous section. These staff members supplemented the professional development opportunities offered by the district or by outside vendors' workshops.

The first model, which we call "In-House," characterizes the full-time instruction-technology support staff present in four school buildings. The second model, present at two of these schools, relied upon "Computer Class Teachers" for at least part of their technology integration support staff for technology. These teachers worked full-time in their own classrooms teaching computer skills to students. They co-planned the content of those courses with other classroom teachers and also made presentations to the school staff. (See table 3.)

A third model of staff was for all of the instruction-technology support staff to be staffed from the district level. At two of these three sites the scope and direction of the technology integration originated from the district level. In Jennings School District the superintendent dedicated two former classroom teachers to provide integration support to the teachers who participated in their district's training and received technology classrooms. The Lemon Grove School District had one person teaching much of and coordinating the entire district's technology

professional development program, but experienced teachers who also led classes aided her. At the third site, their half-time instruction-technology support person was staffed at the district level. At Canutillo Elementary School the funding for this staff position came from and was staffed at the district level, but the school formulated its own vision for technology use. (See table 3.)

Table 3 summarizes the title of the instruction-technology support staff personnel, and lists what staffing model was in place for these personnel. The last column also indicates the number of full-time equivalent staff (FTE) represented by the technology integration support staff.

Table 3
Summary of Innovative Technology-Supported Reforms and Technology Integration Support Staff

School	Title for Technology Integration Support Staff	Staffing Model
Newsome Park	• Technology Integration Specialist (computer class teacher)	Computer Class Teachers (2.0 FTE)
Mantua	• Technology Specialist	In-house (1.0 FTE)
Frontier	• Curriculum Technology Resource Specialist	In-house (1.0 FTE)
Canutillo	• Lead Teacher for Instructional Technology	Outside Staff (assigned .5 FTE to school)
Mott Hall	• Computer Class Teachers	Computer Class Teachers (3.0 FTE)
Mountain	• Student Achievement Specialist	In-house (1.0 FTE)
Lemon Grove	• District Project Director	Outside Staff
Jennings	• Technology Integration Specialists	Outside Staff
Emerson	• Peer Coach	In-house (1.0 FTE)

Leadership from Technology Integration Support Staff

The data presented here focus in on support provided to teachers for their use of technology to contribute to teaching and learning. We present the actions of the staff providing this support as leadership because the actions and interactions of these instruction-technology support staff members provided direction for the instructional uses of technology throughout the whole school and exerted influence on the shape and nature of those uses towards supporting the overall school improvement effort. We illustrate this through examples of how they planned for school wide learning opportunities and interacted with staff about specific lessons. To some degree the methods used were associated with the staffing model in place for the technology support staff; this is represented in the organization of the following two sections reporting our findings.

Providing direction through formal programs of classes.

In the Lemon Grove School District the project director for their large technology grant and the district's technology director worked together very closely; however, the staff development programming was mainly the responsibility of the director of Project LemonLINK,

Barbara White. This site represents an example of the "outside school" staffing model. While a district project director is in a role that is perhaps more readily acknowledged from the outside as a leadership position, from teachers' perspectives, district administrators are sometimes suspect as to how helpful they will be. In this case it appeared that it was Ms. White's belief that learning to use technology in the classroom was a process, and that talking about technology use in terms of curriculum was the best way to engage teachers resulted in an effective design of the yearlong, paid learning opportunity provided to all district teachers over the course of the five-year grant. In an interview Ms. White described how her ideas provided direction for the professional development program she put into place, and as a result, to teachers' learning about educational technology.

The LemonLINK model called for every teacher to participate within the five years of the grant. In order to provide an appropriate point for each teacher to begin at, Ms. White created a program that presented learning about technology as a process and provided differentiated instruction for the teachers. She explained that allowing people to join in at a place that met their needs let her then assert that everyone should be able to participate at some level:

> And when people understand it's a process, you can be anywhere on that process and not feel that you are left out. This is something everybody is going to do. Everybody can do it. You can start here, or you can be here. But we are all on this process and moving along. And we are going to help each other to do that. So we had to build a mind set and get a team of teachers going.

As a part of the activities associated with the professional development sessions she implemented journaling and peers visiting one another's classrooms, in order to facilitate growth along the continuum of learning. She related that she firmly believed that teachers had to see integrative activities in action, so she provided support and a process for visiting another technology-using teacher's classroom:

> And every teacher that's out there will say I didn't understand what you were talking about until I went and saw my colleagues doing it….When we get places where people are far enough along, they have a vision [of technology use], we send them out and we send somebody with them, somebody who is already using it too---we call it guide on the site. We have certain "looked for" we want them to see. Then we come back, and we talk about it.

Ms. White's ideas about adult learners meant she was always comparing the kinds of offerings she provided and their pacing against the group of teachers with whom she was working:

> You have to know where these folks are all the time, because they are all at different stages. And what does this group now need? And you listen..… we don't have a standard thing that we are just doing, doing, doing. You listen, you modify, you change, you give them what they need. And you have different things going on with different people.

An additional way she led the learning about technology in Lemon Grove was by her emphasis on the curriculum as a focal point, and not the technology:

> It was always looking at every curriculum strand and saying, what can we do with the technology to improve everything else that we are working towards as a District. [It was] Technology as training, not as a focus….

She went on to explain how her adopting this focus facilitated "buy in" about the fact that technology could contribute to the classroom and it also set a direction for how technology would be discussed in the schools:

> ….when you focus in on the curriculum, it is a shared belief I would say that they have a vested interested in….So that's a shared thing and you didn't have to really choose it or lead structure toward, because they are teachers. They teach curriculum. That's what is important; by using that as your model, you're choosing something that you would have some consistence on….So I think that was probably an excellent way to bring the technology into this part about student outcomes. You know, they [teachers] want to make a difference with what happens with the student.

Ms. White's expertise concerning the ways technology could support teaching and learning and how to work with adult learners influenced the design and the substance of these teachers' learning opportunities. She provided direction and exerted influence on technology use at Lemon Grove Middle, as well as other schools in the district, by working with the technology director at the district level, the schools' principals, and with the teachers who took part in the professional development sessions.

At Jennings Junior High, the instructional technology support provided was another example of the outside school staffing model; these district level Technology Integration Specialists were two former elementary teachers who were the district's participants in a state-sponsored pilot of the advanced technology classroom model that was later adapted for use in the Jennings School District. From their experiences during this pilot they and the district technology team devised a yearlong professional development model. In this model teachers first participated in the training and then were selected to receive an advanced technology classroom. Through their design and teaching of the training and then recommendations for who would receive an equipped classroom these technology integration specialists exerted considerable direction and influence over how and where technology integration developed in the district.

Ms. Kicielinski and Ms. Moore designed the training at Jennings so that the first half of the year focused on the operation of the technology, and was taught by the technical support staff members, and the second half of the year was focused on integration. They described that the worked to help teachers understand "how do you actually use it [technology] in your classroom as an inquiry base format." She went on to explain how through their modeling and explanation they exerted influence on the participating teachers' developing understanding of the role of the teacher and the technology in a classroom:

> We take them to sites that are educational, sites that we have them look at the different aspects of what is inquiry-base versus what is a worksheet, just reading information. We also show them different sites that they can go into to write lesson plans if they choose to, our server spaces, things that will help them as teachers, but also basically driving home

> the idea of what's inquiry based---changing their philosophy about education from their college education courses. These are out the window, and saying now that there's a tech room, these things are totally different. You become a facilitator. You're not in charge of the information. They are in charge and actively involved in finding the information themselves. You're there to facilitate. So it's kind of getting them to rethink everything they learned in schools.

They further explained that in their monthly learning sessions for teacher who have already received an advanced technology classroom they continue to illustrate ideal uses for the technology by providing examples of useful ideas or materials:

> … we have a monthly meeting with them to go over new things that we've learned while we've been out and about, things we read about, and we also give those teachers the opportunity to bring something that they have found that works in their classroom, whether it be classroom management, or website use, or a lesson.

Through their close work with the teachers throughout this year of training, the two technology integration specialists look for those who they feel would succeed in an advanced technology classroom. The district technology team does set some goals for grade levels and content areas for the expansion of the technology, and tries to select pairs of teachers, so they can help one another learn, but the decision is largely based upon the recommendation of the technology integration specialists. Ms. Kicielinski explained:

> It's an open-door policy; anyone that wants to go to training, we don't refuse. It's just basically, we're looking for certain teachers, though, at the end of that year that will be taking over the [technology equipped] classroom….After that first year we go back and look at the list and we decide who would be a well-suited teacher to have a technology classroom, and that next year they're put into a technology classroom….

These technology integration support staff helped to lead the technology efforts underway in Jennings School District by providing the specific direction to the sorts of uses for technology that were promoted. They exerted influence over who received an advanced technology classroom, which further shaped the how technology was positioned to support teaching and learning.

It appeared that in general, whether the technology integration support staff worked with a school's teachers through whole group or one-on-one learning for staff members depended upon the staffing model in place. The outside school staff models tended to use use the whole group models. Next, we illustrate how when the technology integration support staff members were located in a school the direction and influence from these staff members tended to occur through one-on-one help for the school's teachers.

Exerting influence through one-on-one work with teachers.

At Newsome Park Elementary the technology integration support staff members are also computer teachers to students on four out of five days of the week. Mr. Klaud indicated that at the time of our visit the students' time in computer class served as prep time for teachers; since

this meant the teachers were not in the lab with the students, these sessions were not a time for teachers to learn along side their students. Mr. Klaud and Ms. Gray hoped to in future school years to implement a different way of scheduling students into the lab that would even better facilitate complementary instruction between the computer and classroom teachers. At the time of our visit, Mr. Klaud and Ms. Gray worked to co-plan with the classroom teachers so that the time the students spent with them during the computer class in the lab complemented what the teacher needed the students to be able to do in class. Ms. Gray explained how she attended grade level meetings to stay abreast of what was happening and also made herself available to go into classrooms:

> Basically I invite them into the lab if they want to be a part of what's happening so they can see that. Also if they have anything that they want implemented into the classroom and I can come in and help with, I can do that….Basically it's the training in the lab and working with them through that and through the grade level meetings and trying to understand how we can help that way. That's our main communication line.

It was through this co-planning and impromptu one-on-one sessions with teachers that they were able to provide direction and exert influence on the uses of technology.

Newsome Park Elementary School's computer teachers tried to schedule their lessons so that the limited number of sessions for each teacher's students were grouped close together. This facilitated the students' recall about what they learned, and that the technology components linked to what the classroom teacher was doing. Through the ideas they suggested to teachers for students to learn and by ensuring students were able to readily use the technology they influenced both how and how much technology supported instruction at the school. Ms. Gray shared an example of this in describing her work with a third grade teacher:

> Ms. Price wanted to do her spreadsheet in her classroom. I was doing the jellybean count [spreadsheet exercise in computer class]. She came in the lab and she was telling me what she was planning to do. And I said well I'm planning to do this, come and be a part of it, and then it might make what you're doing in your classroom easier. She came in the next week and was very much a part of what was going on. Now she's doing it [spreadsheets] in her classroom because the children now know how to implement and move through the program where before they didn't have a clue. They thought a spreadsheet was something you put on the bed. Working through it and helping them to understand that it is a program where you're putting information into columns and cells and rows and then all of the sudden it comes to life. And then while we're working on it we say, "This is what we're doing. This is why we're doing it." Then she can pick that same knowledge up and put it into what she's doing….Like Mrs. Price said last night, they were able to go and do their spreadsheets with [their project on] buildings because we had done the jellybean count in the lab.

These staff members also helped to lead the learning about technology in this school through Mr. Klaud's membership on the school leadership team that oversaw technology. In addition, they offered professional development sessions for the entire staff of Newsome Park when the district supported paid time for the teachers to learn and also upon request sat down with teachers to help them learn a new piece of software or how to operate hardware, such as a digital camera. Ms. Gray explained "we're always trying to stay right up on whatever's

happening and keep the teachers involved and informed… there's always training going on even if it's not a sign up [session]. It's forever one on one. There are phones in every room; if they need us they give us a call. There's always an open door policy for them if they have a need."

At West Middle School, the technology integration support staff person was at the school, and so an example of the in-house staffing model, but was funded partially by the district, which had a strong focus on technology, and standards-based instruction and students' achievement of them. As a result, Ms. Martinez's title was Student Achievement Specialist, and while planning with teachers one-to-one and through more formal staff development activities she provided direction for the district's intent that technology would support students' achievement of curriculum standards. There was another Student Achievement Specialist at the school as well, but she worked on staff development and student achievement as it related to standards, leaving the technology specific work mainly to Ms. Martinez.

Ms. Martinez indicated that as the school's teachers' technology skills had developed the classroom teachers had taken over teaching their students how to use the technology and as a result, she now spent most of her time working directly with teachers. She offers learning opportunities on a three-tier model. The first tier is direct instruction on how to operate new software or hardware; these sessions are scheduled as needed and developed from a needs assessment she conducts. Tier two is directed at integration support, and she offers this mostly through one-on-one planning. The third tier is a coaching model, which she facilitates among the teachers. Tiers one and three can allow teachers to earn credit towards advancement on the district' salary schedule.

During the time she works with teachers one-on-one she is able to direct their efforts towards aligning technology to the curriculum standards. She described to us how standards were a newer point of emphasis from the district and provided an example of how she was regularly leading teachers in that direction.

> I think that having the standards to look at helps us to really define what we're doing and look at it a little bit more closely. So that when we go to plan lab time with teachers, instead of, "what do you want to do and what program do you want to use", it's more, "what standards are you trying to address through this lesson". So it's changed the way that we plan….we really talk about what are students going to be able to do as a result of this activity, and relating that to the achievement of the standards.

She also described using a template to guide technology integration planning and that through it she directed teachers' attention to standards.

Ms. Martinez also exerted influence on technology uses in the school through the way she set up other learning opportunities for teachers. She was in charge of facilitating the Vanguard Program, a tier three professional development effort they described as leadership training. In it, five teachers in the school were designated as coaches; each teamed with another teacher to plan a unit and then the coach presented the lesson, the coachee observed it, and they debriefed and talk edabout what they saw. They then switched roles. Through her facilitation the teachers developed ways of talking about technology with one another, ideas for classroom uses, and start to shape a model of successful technology use at the school.

At Emerson High School Ms. Zacagna was in the role of Peer Coach. The main thrust of her job was to help the school embed the instructional approaches of whole language and cooperative learning throughout the school. Because technology had been identified by the school leadership team as an important support to that, she provided one-on-one support to teachers on technology integration. She asserted that because she was in no way responsible for

the evaluation of teachers as they tried out these instructional approaches, they were more willing to approach her:

> And the first year, the first two years [of her four year in this role] maybe, the seasoned teachers were very hesitant about coming to me and asking me anything. Now they're not hesitant at all, because I do not evaluate. I support. And that is a key….When I sit down with a teacher, I'm telling the teacher that I'm there to assist them with all their problems. If they think that I'm going to evaluate them, they're not going to tell me what their problems are. They'll be very hesitant.

Thus, it was through her non-evaluative approach in working with teachers that she was able to exert a greater influence on whether or not they would try these methods and, in general, move in the direction of the school goals.

Summary

Specific contextual conditions allowed these technology integration support staff members to be effective. The prior condition of teachers' sufficient access to reliable, working technology was met and so the teachers and technology support staff could focus and collaborate on technology integration. That is, knowing that they could use working equipment when they needed to seemed to let teachers focus on learning how to use the equipment to support students' learning.

The leadership for these substantive changes to the core teaching and learning in these schools came from a team of people. In this team, the instruction technology support staff members were absolutely key, but would not have achieved these outcomes working alone. Rather, they supported the learning phase that was a necessary part of the overall school improvement effort.

The power and practices that the technology integration support staff members could access and use were related to their position, and more constrained than, for example, a principal's, but were sufficient, as evidenced by their overall effectiveness. Instead of their power to make change coming from line authority, it came from their expertise, and the fact that the teachers chose to work with them. The working relationships surrounding these instruction-oriented positions were voluntary and motivated; teachers saw these support staff as providing essential help, and thus as important leaders towards the overall school improvement effort. In that way, the nature of their leadership was more transactional, than transformative.

Implications and Conclusions

Dexter, Anderson, and Ronnkvist (2002) characterized technology support according to its content---technical or instructional---and the method by which it was delivered. They described technical support as focused on the access to, and operation and troubleshooting of hardware, software, and network resources and instructional support as focused on integrating technology use into curriculum and enhancing different teaching methods. They also described technology support in terms of the types of resources used to deliver such services, including facilities, support staff, professional development, including one-on-one consulting, and incentives. (See table 4). Drawing upon teacher survey data from a national probability sample of schools, they found that quality technology support positively impacted both teachers' own uses of technology and their integration of it into their classrooms.

Table 4
Technology Support Content by Resource Type used to Deliver Technology Support to Teachers

	Technical content	Instructional content
Facilities	Network and Internet access; hardware, software	Content-area specific software, communications access to pedagogical expertise
Staff	Computer experts for trouble-shooting	People providing instructional support have instructional expertise and background
Services	Technical support; help desk; network services; opportunity to learn about operating equipment and software	Guided practice; personal consultation; technology pedagogy and integration strategies
Incentives	Free hardware, software and network access; anticipation of expert status	Release time for support focusing on instructional content

This study builds upon the technology support framework and findings from Dexter, Anderson and Ronnkvist (2002) by illustrating how technology support is one component of technology leadership. This study illustrates how support is not just a matter of consulting with teachers about their technology issues, but it is a matter of using one's expertise to provide technology and instruction ideas, recommendations, and help to the school as a whole. We argue that such support is a form of leadership because without such input, the school would flounder and lose direction in its technology-relevant programs. Discussing support as an aspect of leadership reminds us of how complex changes in schools require significant attention to details, and cannot just be obtained through visionary statements alone---but we do agree that vision is important.

These cases suggest that successfully implementing a complex improvement effort warrants a team-based leadership approach. This appears to be especially likely for an improvement concerned with using technology in schools to support teaching and learning; not only does such an effort include both technical and curriculum and instruction issues, but technology is constantly evolving and many of these changes have implications for teaching and learning. It is more likely that through a group of people working together on technology leadership effort the correct complement of expertise would be available, and that the team could keep up to date and cover all the bases.

A leadership team that together represents the necessary expertise begs the question Toward what end? If the authority and value of a non-positional leader stems from his or her expertise, as was suggested in these cases, then perhaps a prior conditional contextual factor for team based leadership must be a widely agreed upon need to learn, in order to validate the expertise offered by various members of that team.

Just as any teacher provides direction for the study of course material and exercises influence over students' interactions with it, and their eventual constructed understandings, so did these technology integration support staff. However, in that their charge was derived from a whole school improvement effort and their students were the teachers of the school, their leading

the technology learning for the school's teachers was an important part of the site's technology leadership.

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