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K-12 Technology Audit: Lessons for School Leaders

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ABSTRACT: This article synthesizes findings from a technology audit to evaluate technology use and integration in the district of a moderate-sized suburban school district in a mid Atlantic state in the U.S. Survey and interview data were analyzed from administrators, teachers, students, and school board members. This district had in place a detailed technology plan yet half of the teachers and one third of administrators surveyed had no knowledge that the plan even existed. Issues such as access, pressure to cover content for standardized testing, and a strained relationship between the Information Technology department and the faculty emerged as barriers to effective implementation. Perhaps the greatest obstacle exposed by the audit was the district's lack of vision to fuel growth, innovation, and risk-taking. Implications are discussed.

Much has been written about technology integration in K-12 schools over the past decades. Barriers to effective integration have been identified and innovative schools have been held up as models (e.g., Schibsted as cited in Roundtree, 2006). The million dollar question of course has always been Does technology impact learning? The wise, seamless integration of technology into the K-12 curriculum has been one of the most vexing challenges for educators and researchers alike. In 2002, Earle categorized the research on barriers and constraints into the following categories: access to hardware and software, time for teachers to plan and develop skills, technical and administrative support, training and expertise, resistance embedded in school cultures, lack of vision and leadership, and support for integration into instruction. Ertmer (1999) grouped these barriers into two categories, first-order (access, time, etc.), which are external to teachers, and second-order barriers, like teacher attitudes and beliefs. She argued that in many cases, teachers identify first order barriers as the justification for not using technology, but when those barriers are removed, they still resist, implying that first order barriers can mask more deeply rooted beliefs. More recently, Ertmer (2005) described teacher beliefs as the "final frontier" to conquer before widespread seamless integration is possible.

Research in this area has focused largely on classroom practices and teacher behaviors and attitudes. Barriers to technology integration at the building and district levels, however, are not as well understood (Baylor & Ritchie, 2002). While access and availability foster integration (Silvernail & Lane, 2004), other barriers, including the district context, can affect teacher learning in powerful and detrimental ways (Ertmer, 1999; Zhao & Frank, 2003; Zhao, Pugh, Sheldon, & Byers, 2002). It is true that leadership, vision, and school culture are mentioned in virtually every discussion of critical factors to consider when planning for successful technology implementation, but what that looks like, and how failures "at the top" impede the overall effort is not well investigated. Do school administrators even recognize effective technology integration when they see it, much less evaluate it? Do school district leaders (e.g., board members, superintendents, and principals) have a realistic expectation for the return on the huge sums of money they have invested in technology? Perhaps at the heart of these rhetorical questions is a fundamental disagreement over what technology should and should not do. Perhaps technology investment proceeds unabated because technology and communication competencies are perceived as life skills for the digital age, as important as the 3 Rs.

Schools throughout the U.S. and Canada invest mightily in technology often without a clear idea of what changes are expected to occur, or how those changes will be detected and measured. Despite the fact that school districts have developed well-conceived, multi-year technology plans, very few have identified clear measurable outcomes, or have instituted a robust assessment system to measure progress. In other words, many school districts have not established benchmarks, and those who have, do not systematically measure progress against those benchmarks. Districts simply do not know with certainty what barriers they face, much less how to address them.

School and district leadership would benefit from sound evidence that extends beyond the question of whether a particular technology impacted student achievement or attitudes (Honey, McMillan, & Carrigg, 1999; Norris, Smolka, & Soloway, 1999). Rarely do empirical studies examine the overarching issue of district wide technology planning and integration, the fusion of what some might call the "ingredients" for successful technology implementation (Zhao et al., 2002). We had such an opportunity recently, when a middle class, medium-sized school district (*Roanoke School District*, pseudonym used) in a mid-Atlantic state asked us to conduct a comprehensive technology audit. The full results of that audit are proprietary1 but we synthesize here the main findings of that effort. Generalizing the results of one school district is risky, so we advise caution. This is of course, only one data point. But we believe the challenges

Roanoke school district face are not unique, and that many if not all districts will benefit from the telling of their story.

We organize this paper into several sections. First, we discuss the background and context of the audit, describe the data collection procedures and instruments, summarize the audit activities, and discuss and explain the enGauge framework, which was the theoretical foundation for the audit design. Next we report the results of the audit organized around the enGauge framework with specific recommendations (to-do lists) to address specific challenges identified by the audit. Finally, we discuss the findings and implications of the results.

It Takes a District: Lessons Learned from a Technology Audit

Measuring technology integration is an inexact business. What are we measuring? How do we define and to whom do we compare technology integration? The audit was commissioned by the district superintendent with the goals of evaluating technology use and integration in the district, identifying areas of strength and concern, and providing recommendations for future use and integration. The audit was conducted over a period of approximately two months. The following is a summary of the audit method and activities:
o Met with superintendent to discuss audit goals

o Proposed audit activities to Roanoke administrators at the Superintendent's monthly administrator meeting. The purpose of the presentation was to explain the goals of the audit, inform them of upcoming activities, and gain support for the process. Based on the administrator feedback, we designed and distributed 'straw man' survey instruments for further review and revision. We decided upon two main data sources, focus groups and survey instruments.

o Focus Groups. We identified key stakeholder groups in the district and scheduled eight sessions to interview them over a four-week period (See Figure 4 for guiding interview questions). We met with seven groups of elementary teachers (N=7), middle school teachers (N=10), high school teachers (N-12), elementary school principals (N=6), middle and high school principals and assistant principals (N=5), Information Technology (IT) staff (N=10), and Academic Services staff (N=5). For the last stakeholder group, the School Board, we met with and interviewed four members individually (out of a total of five). The purpose of the interviews was two fold: (1) to develop a rich understanding of the resources, relationships, history, issues, needs, and perspectives surrounding technology use and integration in the district and (2) to inform the development of the survey instrument that would later be sent to students, teachers, and administrators. We did not interview the superintendent himself because he was the consumer of the information and did not want to confound the process by inserting his views.

All interviews were tape-recorded and later transcribed and analyzed using a grounded theory, ethnographic approach (Glaser & Strauss, 1967; Henwood & Pidgeon, 1994; Strauss & Corbin, 1990). We used thematic analysis to derive patterns and themes from the interview transcripts while maintaining subjectivity (Braun & Clarke, 2006). We were required to submit the report to the superintendent before we could complete member checking with the interviewees (to confirm accuracy of our conclusions). Interview questions are included in Figure 4.

o Survey Instruments. Based on the focus group interviews, we designed three short surveys, Administrator, Teacher, and Student to measure Roanoke's ability to meet the enGauge essential conditions outlined below. Each instrument (included in Figures 1, 2, and 3 respectively) included items designed to measure elements of the six conditions. The surveys were administered to all administrators and teachers in all grades, and to students in Grades 3, 5, 8, and 11. Three hundred eleven teachers (of a total of 750), 1,850 of the 2,199 registered students in the target grades, and 18 administrators completed the surveys.

The audit design is grounded in the enGauge conceptual framework developed by North Central Regional Educational Laboratories (NCREL). EnGauge identifies six conditions that are essential for a school district to use technology effectively (http://www.ncrel.org/engauge/). The six essential conditions, which are not linear or hierarchical, are:
o Forward-Thinking, Shared Vision. Effective school districts build a shared, research-based, community-based vision that prepares students to succeed in a knowledge-based, information-rich society. The vision is clear and easily articulated by all stakeholders, and is communicated often to community members.

o Educator Proficiency with Effective Teaching and Learning Practices. In successful school districts, educators are proficient users of technology in teaching and assessing a variety of effective learning practices.

o Digital Age Equity. Effective districts address the digital divide by providing resources and strategies, ensuring that all students, regardless of race, socioeconomic status, gender, and special needs, are engaging in programs consistent with the vision.

o Effective Teaching and Learning Practices. In effective districts, learning environments are often characterized by powerful, research-based strategies that use technologies.

o Robust Access Anywhere, Anytime. Effective districts provide and support anywhere, anytime access to adequate and strategically-placed technology with adequate connectivity and bandwidth.

o Systems and Leadership. Effective districts 'reengineer' themselves into high-performance learning organizations by initiating high performance standards, cultivating and rewarding creativity and innovation, requiring administrator proficiencies, providing comprehensive professional development, prioritizing adequate technology funding. Measuring whether Roanoke satisfied these conditions provided an organizing structure for the audit. The overarching question we attempted to answer was "To what extent does Roanoke compare to a model school district?" Findings from this recent district technology audit hold important implications for administrators who hope to integrate technology more and effectively and efficiently.

Summary of Audit Results

This section synthesizes the findings from the surveys and focus group interviews. It is organized around the six conditions outlined by the enGauge framework. After a summary of the data related to each condition, we offer specific recommendations in the form of to-do lists for district leadership.

Vision. The conventional wisdom among teachers and administrators based on the focus group interviews was that if teachers have access to more computers, then integration would follow- a kind of "add technology and stir" mentality. This thinking is understandable as not much technology integration can occur without technology, but it is also naïve. There are many cases where integration did not follow access (Cuban, Kirkpatrick, & Peck, 2001; Hofer, Chamberlin, & Scot, 2004; Parr, 1999). Indeed, these teachers had access to a reasonable inventory of tools that, while not state of the art, were not being used.

When focus group participants were asked "What does effective technology integration look like?" (see Figure 4) the responses were almost universally vague and tended to focus on hardware issues (lack of, underperformance). Each administrator seemed to have developed his/her own technology vision independently and communicated that vision, although not usually explicitly, to staff. Instructional personnel had poorly defined goals for using technology and, in most cases, fell into predictable patterns, such as using computers for test review or (in the high schools) working through assigned programs in the computer lab like Plato Learning systems.

Many teachers saw their school's computer teacher as the one who "teaches the kids how to use it." Few teachers mentioned student use of computers to work on in-class projects in their description of their technology integrations vision. The bottom line was that we could not determine a generally accepted, high-level, long-term district-wide vision for technology. Interestingly, this district has had a technology plan in place for years. However, over half (176) of the 311 teachers who responded to the survey (item 13, Figure 2) and six of the 18 administrators indicated that they were not aware of the district technology plan, or their role in it (item 7, Figure 1).

The vast majority (95%) of teachers (item 19, Figure 2) and all of the administrators (item 12, Figure 1) surveyed believed that effective technology has the potential to improve student achievement ("I believe that effective use of educational technologies can help improve student achievement.") The teachers who used computers, however, did so in ways where one would not expect to see achievement impact2, e.g., PowerPoint presentations (Kozma, 1994; Means, 1993). Teachers still seemed to be consumed with the "what can I do with it" question and have only begun to conceptualize how their students might use these tools. Over half of the students responded that they thought their parents expected them to learn more about technology in school.

Meaningful technology integration requires a long-term commitment with significant professional development implications (Eaton, 2005; Parr, 1999; Swain & Pearson, 2002). Yet, it is still fairly common for school districts to invest in computers and infrastructure without clear expectations for usage or an aggressive plan for training (Hinson, Laprairie, & Cundiff, 2005; Keller & Bichelmeyer, 2004; Means & Olson, 1995). This district seems to have fallen into this category.

To-Do List: Vision
* Define, articulate, and communicate a technology vision. Develop or revise current technology plan. The vision needs to be developed and owned by teachers, so it is not perceived as a top-down mandate, imposed by the administration and/or the IT department. All players, teachers, administrators, and school board members need to know and understand the plan and champion it.

* Allow students to use equipment freely. Beware of the misconception that equipment is expensive and needs to be

tightly protected from falling into young, unsupervised hands. Students will learn to be responsible. And if equipment breaks, replacement costs are very low now. Making these digital tools ubiquitous is an important message to send to the school community.

* Provide/guarantee building level technology support positions.

* Develop a long-range budget with an aggressive replacement cycle. Improve infrastructure and student-computer ratios to make these tools readily available. Invest in wireless technologies.

* Invest in professional development. Provide time and resources to allow teachers to figure out what to do with technology to improve student outcomes. Allow teachers to set their own goals.

* Include technology integration in all personnel evaluations. Reward innovation.

Educator Proficiency. During the focus groups, there was general enthusiasm for technology's, and in particular the computer's, ability to motivate students and to improve instructional opportunities for students. The teachers, however, were not satisfied with the quality of professional development that the district provided for technology. Computer training has followed the workshop model, and has been almost exclusively application based (e.g., learning how to use Excel). The training has tended to reinforce the general perception among teachers that the computer is an add-on, something to be learned that is independent of what "really happens in the classroom." This view was communicated quite clearly in the focus groups. There was a good deal of concern among teachers that the training was fleeting and was as one teacher put it, "a game that everyone has to play." This is in sharp contrast to the view held by the IT staff, and by school board members, who believed that the district offered "tremendous opportunities" for teachers.

On the proficiency front, teachers reported their technology skills to be at the "Adaptation" stage, or "using technology as a tool to accomplish a variety of professional and instructional tasks," which is the third stage in a progression of five integration stages (item 10, Figure 2) identified by Sandholtz, Ringstaff, & Dwyer (1997) based on their research with the Apple Classrooms of Tomorrow (ACOT) initiative. This self-appraisal was consistent with administrator views of teacher skills (item 2, Figure 1). Students sampled across the four grade levels agreed or strongly agreed that their teachers liked to use technology. While very few teachers or administrators rated themselves at the Invention stage, the great majority were comfortable using computers, which is encouraging. And 80 to 90 percent of students reported that they believed their teachers liked to use technology (item 8, Figure 3).

Teachers and administrators both reported frustration in the interviews that they did not have enough time to share promising practices and experiences with colleagues. Administrators and teachers alike seemed surprised to hear what other schools in the district were doing with technology.

To-Do List: Educator Proficiency
* Re-conceptualize training to align with vision (once vision is redefined). Make technology a fundamental part of curriculum and instruction, where it is folded into lesson planning, evaluations, and personal and team goal setting.

* Provide funding for teachers to attend professional conferences. Reinforce that stand-alone training sessions are insufficient to move beyond seeing technology as an add-on.

* Use students in innovative ways as part of the solution to technology integration. Students can teach.

* Use district teachers and university preservice students (if available) to conduct in school inservices. Universities are often willing to partner in providing learning experiences for their students.

* Establish a technical and integration help desk for teachers and administrators.

Digital Age Equity. The percentage of students reporting that they have computers at home with Internet access was very high (item 4, Figure 3), approaching 95 percent. Teachers and principals both grossly underestimated that number (item 5, Figure 2; item 3, Figure 1), both groups estimating the percentage to be between 51 and 75 percent. These numbers are encouraging and will likely approach 100 percent in the near future.

To-Do List: Digital Age Equity
* Open more schools after hours to students and the general public to build the community connections that are needed to support additional expenditures on technology.

* Collect data each year on student access (connectivity, usage), which will inform district decisions.

* Encourage teachers to build online course Web sites that support and extend instruction and provide a link to parents. An overwhelming majority of the district community has Internet access outside the school.

* Help parents/families help their students use the Internet and computer safely both for school projects and to review online course sites. Schools should partner more deeply with families to face together the challenges presented by a digital age.

Effective Teaching and Learning Practices. The focus groups revealed friction between the Informational Technology (IT) department and the instructional staff. When asked about teacher empowerment with respect to technology use during the interviews (question 5, Figure 4, Do you feel empowered to creatively use computers in your classroom?), some teachers reported that the IT department seemed at times "to direct," rather than support them. Others indicated they felt intimidated by the IT staff and consequently stopped asking for help. One principal strongly recommended that an instructional person oversee IT, "It is easy for them [IT] to lose sight of the fact that instructional needs drive the technical solutions, technical limitations should not drive the instructional options." A number of teachers believed that communication needed to improve between IT and the faculty. The IT department during their focus group seemed, by and large, to be unaware of, or reticent to talk about, the tension expressed by the teachers. They seemed very accommodating and committed to supporting teacher needs. The IT staff voiced frustration about the lack of resources and aging equipment, resulting in maintenance headaches that frustrated teachers and students.

The district did not provide what teachers called a school-based "technology integration expert," or dedicated support person to help design curriculum resources and integrate lesson plans. This lack of help-both in the classroom and in planning-was the most common obstacle cited by teachers interviewed in the focus groups. There was considerable frustration with the lack of support in this area.

Several items measured how the availability of computers in teachers' classrooms affected frequency of use, and how they were used. In response to the question (Figure 2) "What is the minimum number of networked computers you need in your classroom to use them often for instructional purposes?" 77 (49%) of K-5 teachers indicated they needed at least 2-5 computers, compared to only 18 (28%) of high school teachers (the two high schools tended to use the centralized computer lab model more than the seven elementary schools). In response to a slightly different question (Figure 3), "How often do you use computers in school?" 64% of the Grade 8 students reported that they used computers either "Hardly at all" or "Once a month." Third and fifth graders tended to respond either "Once a month" (35% and 48% respectively) or "Once a week" (35% and 48% respectively).

We hypothesized that high-stakes state tests might discourage creative teaching at some level, and included survey items that attempted to measure if testing affected creative use of technology. Sixty percent of all teachers either agreed or strongly agreed with the statement "The pressure to cover content (for end of year state exams) prevents you from trying new things with technology" (item 14, Figure 2). Interestingly, only seven of the 18 administrators viewed this pressure as an obstacle in the same way, revealing a disconnect between the two groups (item 16, Figure 1).

To-Do List: Effective Teaching and Learning Practices.
* Make available a trained technology integration expert at each school.

* Ensure that principals have control over some part of the technology budget (if centralized). Building leaders need the ability to purchase technology resources for their school. If administrators own more of the technology decisions, they will invest more in the process and outcomes.

* Institute a district wide Advisory Board to advise and consult IT on purchases and installations.

* Constitute technology committees at each school with clearly defined authority and responsibilities. Give the committees a budget. Teacher ownership and empowerment are key factors in overall buy in.

* Make school labs available for open use for teachers. In other words, do not block out lab time for the technology teacher classes. Encourage, even require, that teachers collaborate with the technology teacher or library media specialist.

Robust Access. All stakeholders in the focus groups raised concerns about hardware and network performance. School Board members frankly admitted that equipment and connectivity needed upgrading. The infrastructure had become outdated. Speculation on why that is so is included in the next section, Systems and Leadership.

This district had no replacement cycle for technology. Purchases and upgrades were made throughout the district, but there was no systematic policy. Each year, the amount spent on technology upgrades is negotiated anew. Thus administrators cannot plan long term to align instructional and technology needs. The administrative software system was also a concern, with curriculum coordinators and principals frustrated by its inflexibility in generating custom reports and inability to track and analyze student data across grade levels.

Access to computers is a major obstacle for teachers with typically only one computer per classroom. The labs are fully booked with technology classes making it impossible for teachers so inclined to take a class there for full class activities. One teacher remarked, "Computers? What computers? Why should I even waste my time thinking about how to use them when there is no place to go?" In sum, there is little opportunity to be creative with technology. However, all teachers and principals praised the current policy of staffing at least one IT person in each school to provide onsite technical (not integration) support. That has begun to make a difference. Teachers reported that they are now willing to "take risks and try things because I know Mary [pseudonym used] is here."

At least one mobile laptop was available at each school but was not used frequently. Teachers complained that the laptops were outdated and slow and difficult to coordinate (for use in their classroom). Other equipment, such as digital cameras, were popular and are used more widely but were also in short supply. Teaches and school staff typically did not allow students to use, or even hold, equipment like the cameras.

Many elementary and middle school teachers described access to computer labs (item 4) as "inadequate" (21 and 35 percent respectively). Forty percent of elementary and 30 percent of middle school teachers rated the Internet connectivity (item 7) at their school "too slow to use instructionally," and about half (49%) of middle school teachers and 30 percent of elementary teachers either disagreed or strongly disagreed with the statement (item 15) that they "received adequate help in planning and integrating technology into instruction from the technology resource person at your school."

High school teachers responded more favorably about their access to and performance of the computers in their schools, and were generally satisfied with the instructional support they received. But ironically, at the time of this audit there were no computers in the classrooms at all in the high schools (in favor of a centralized lab approach), so it was possible that teachers who did not use the labs, reported general satisfaction, whereas teachers who used the labs had the support of two dedicated instructional staff. In other words, if you don't use it, you don't care; if you do use it, you are happy because the lab is supported. Thus, accepting this arrangement sets the bar exceedingly low in our estimation. It caters to and supports only those who have the initiative and desire to grow and innovate, but enables teachers who choose to never change to go unchallenged.

Younger students (3rd and 5th graders) were reasonably happy with the number of computers available in schools and the performance of those machines. Older students, however, were less impressed with only 12 to 13 percent of 8th and 11th graders describing their school's computers (item 5, Figure 3) as either "fast " or "really fast."

To-Do List: Robust Access

* Perform a network audit and create a plan for providing/improving broadband access to every node on the network.

Systems and Leadership. Interviews revealed that the culture at Roanoke leadership did not really support or value high level technology use; meaning that computers were not used to support student inquiry or to engage students in authentic problem-solving. Technology use was not part of the personnel evaluation scheme for either teachers or administrators. How can a school district expect meaningful technology integration to occur if (a) they don't know what it is they are looking for, and (b) have no way to reward it if they did. With vague technology expectations, administrators did not see their role as technology advocates. Teachers and administrators reported that they received "adequate" support from their administrator and district. But it would be difficult for them to believe otherwise since they have never been given clear goals for technology use or evaluated on how they used the tools.

Each of the four School Board members we interviewed agreed that equipment and connectivity needed upgrading, and that more money needed to be allocated to such initiatives. They did not, however, accept responsibility for any under-funding that occurred over the years. Instead, they seemed to lay that responsibility at the feet of the superintendent(s), who was charged with preparing the budget and setting district priorities.

To-Do List: Systems and Leadership
* Aggressively fund initiatives to reach goals identified in technology plan. Establish clear measurable outcomes; institute a robust assessment system to systematically measure progress.

* Create a multi year budget for technology with training, and a three-year replacement cycle for equipment

replacement. Converting all buildings to wireless should be a priority.

* Include technology line item in each school's budget to empower principals and the teacher-led technology committees to make and act on technology decisions.

* Evaluate the district's organizational chart. We have found in Roanoke and in other districts that problems tend to result when two different district leaders oversee instruction and IT. One solution is to have one person responsible for both. We discuss this later in this paper.

* Encourage all stakeholders, teachers, administrators, and the school board, to know the technology plan and to be advocates for the wise integration of technology.

* Provide "consuming support and gentle pressure" to use these tools in meaningful ways in the classroom (Strudler & Wetzler, 1999).

Summary of the Findings and Recommendations

The following table summarizes the key findings and recommendations from the audit organized around the six essential conditions from the enGauge framework.

Condition	*Findings*	*Recommendations*
Vision	Lack of collective vision for technology integration Minimal knowledge of technology plan district-wide Lower-order usage of technology in the classroom Lack of understanding regarding effective technology integration	Define, articulate, and *communicate* a collective technology vision Provide/guarantee building level technology support positions Develop a long-range budget with an aggressive replacement cycle Improve infrastructure and student-computer ratios to make tools readily available Invest in wireless technologies Invest in professional development by providing time and resources; allow teachers to set their own goals Include technology integration in all personnel evaluations; reward innovation
Educator Proficiency	Application-based workshop model for professional development reinforced teacher perception of technology as an "add-on" Lack of time for teachers to experiment with technology and share integration ideas and best practices with colleagues Most teachers reported skill at Adaptation Stage (using technology as a tool to accomplish a variety of professional and instructional tasks); level three of five integration stages on survey	Re-conceptualize training to align with vision Provide funding for teachers to attend professional conferences Use students in innovative ways as part of the solution to technology integration Use district teachers and university preservice students (if available) to conduct in school inservices Establish a technical and integration help desk for teachers and administrators

Findings from this audit reveal that the barriers cited by Earle (2002) and Ertmer (2005) are present in the Roanoke district. Both first-order barriers (access to hardware and software, lack of time for teachers to plan and play with technology, lack of support in terms of a technology integration specialist) and second-order barriers (lack of collective vision) emerged as factors preventing effective integration of technology in the Roanoke district. In this audit, barriers resulted from a lack of district-wide planning and vision. When district leaders with the power to shape policy identify and understand both the first- and second-order barriers that are present in their districts, they can begin to address them systematically.

Discussion

In this section we present specific recommendations that, although based on the results of just this one audit, have some applicability to all school districts. Most of what we advise is not new. Rather it is a practical roadmap that may help administrators avoid some of the persistent challenges rooted in practice.

As described above, the Roanoke district was operating under a detailed plan for technology implementation, yet half of teachers and one third of administrators had no knowledge that the plan even existed. Additional issues such as access, pressure to cover content for standardized testing, a strained relationship between IT and the faculty, and general faculty proficiencies emerged as barriers to effective implementation. Ironically, teachers' concerns with passing the state's new technology assessment for instructional personnel reinforced their view of technology as an add-on, stand-alone rather than as a powerful interactive learning tool. The greatest obstacle exposed by the audit was the district's lack of vision to fuel growth, innovation, and risk-taking.

Perhaps the two most intriguing findings from this effort were (1) the lack of vision and direction despite the existence of a district technology plan, and (2) the strained relationship between the IT department and instructional personnel. These are intriguing because they are not easily detectable. It is not likely that a district administrator will publicly proclaim that his district is not integrating technology or that she has a dysfunctional staff. It is quite likely that many administrators are not even aware of either problem. We talk about each in turn.

It is probably true that at the root of all of the problems identified here is a lack of vision and leadership. And we would argue that this is a systemic problem, plaguing the majority of school districts, even well-run and successful districts, in the U.S. and Canada, We attribute this condition to two admittedly intertwined factors:
o Lack of understanding of what technology integration looks like
o Relatively low priority for all meaningful technology integration.
Teachers and administrators are often unaware of what they need to do to achieve powerful and effective technology integration. Sixty-nine percent of teachers agreed or strongly agreed with the survey item, "you receive adequate help in planning and integrating technology into instruction from the technology resource person at your school," and 84% of teachers indicated that they were satisfied with the support. Seventy-two percent of teachers indicated that they felt support from administrators and 59% of teachers indicated that they felt support from the district. Ninety-seven percent of teachers and 100% of administrators indicated that "the effective use of educational technologies can help improve student achievement." With such an overwhelmingly positive attitude in place, it is surprising that only 56% of teachers indicated that they used technology as an instructional tool. Sixty-four percent of students indicated that they used computers to "create something" hardly ever or only once a month, while roughly one third of students (34%) indicated that they used a computer hardly ever or only once a month. Research suggests that meaningful integration requires access and availability (Silvernail & Lane, 2004) and curriculum transformation (Cuban et al., 2001; Cummings, 1996; Office of Technology Assessment, 1995; Zhao et al., 2002). That teachers and administrators are satisfied with the support they receive even when the conditions necessary for effective integration are not in place indicates a fairly naive understanding of effective integration.

Many administrators truly believed that technology was being used in meaningful ways. Even among those who did not believe that technology was being used in meaningful ways; few seemed to have the determination and persistence to change. It required too many resources and too much change, with dedicated and sustainable resources for developing and maintaining infrastructure. Wise integration requires significant long-term planning and budgeting and aligning with the state curriculum. And it involved answering the questions of how teachers and administrators are accountable and how they will be rewarded and evaluated. To confront these issues requires change at the deepest level. It requires a shift in the institutional culture that most administrators are not willing to make.

The second point, that technology is a low priority, relates to the reality of high stakes testing. We contend testing impedes innovation despite the fact that in many districts, technology occupies a reasonable chunk of the overall budget. Preparing students for state-mandated assessments is at or near the top of administrators' priorities, and competes with all other initiatives, including technology integration. This is understandable, especially in light of the equivocal findings regarding the computer's ability to impact learning. Researchers cannot on the one hand clamor for greater use of computers to support higher order learning, when they cannot provide empirical supporting evidence. Any vision or plan has to be trumpeted from the top down. The superintendent first and foremost, has to be the most vocal advocate (Hinson, Laprairie, & Cundiff, 2005; Means, 1993). Growth, innovation, and risk taking need to be encouraged in the technology arena.

Beware of the enemy within. We found evidence in the focus groups of strained relations between instructional staff and the IT department. This confirmed our impressions developed over several years working closely in other technology projects with this school district. It is also consistent with impressions we developed from working closely with two other school districts. Neither administrators nor teachers are likely to know much about the technical needs of a school or district, e.g., networks or network security, bandwidth, or minimal system requirements for a particular system. Hence, they have no choice but to trust almost implicitly what their IT staff tell them regarding what they can and cannot do instructionally. Thus instructional needs become subordinated. It soon becomes too easy for an IT director to say "no" to a request simply because it is easier, or safer, or whatever rationale. In the case of Roanoke, it evolved, or degenerated, almost into a tail-wagging-the-dog situation. The result was the perception that IT "runs the technology" in the district, which in turn stripped power from teachers. We observed teachers who seemed to be intimidated by IT, afraid of appearing "stupid." They simply stopped trying anything new because they were told for example, "you cannot load software on your school computer because of network security." The IT department should truly support and be at the service of the instructional staff. But central control of district technology, while convenient for IT, can discourage creativity and constrict instructional options. Here again, we doubt that administrators are even aware of this tension and strongly recommend that districts investigate this potential barrier.

Many specific recommendations were made to the Roanoke, many of which were enacted. In this case, findings from the audit inspired change in the Roanoke school district. Equipped with evidence and information, the school board and superintendent were able to allocate long-term funding to stabilize their approach. They also formed a district technology committee that reported directly to the superintendent. The committee was comprised of teachers and was chaired by one of the assistant principals at the high school. The committee established priorities and gave a strong voice to faculty. They clarified their vision and communicated it better to staff, and they committed to a predictable investment stream to provide stability for planning.

Clearly, there is no shortage of needs competing for budget dollars. Reducing class sizes, rising enrollments, and improving student performance on mandated standardized tests are but a few examples. However, choices have opportunity costs, and in our view, inaction in the technology area runs the risk in the short run of leaving the school system technologically handicapped and in the long term, could lead to mediocre graduates unable to compete in the digital age.

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Figures

Figure 1. Administrator Survey

Please respond to the questions 1-13 on the accompanying Scantron sheet.

1) How long does it take to receive technical support in your school?

a) Several days
b) One day
c) Less than 24 hours (same day)
d) Tech support available 24/7

2) In your opinion, what percentage of your students has a computer at home?

a) 76-100
b) 51-75
c) 26-50
d) Less than 25

3) In your opinion, what percentage of your students has a computer with Internet access at home?

a) 76-100
b) 51-75
c) 26-50
d) 25 or less

4) Please rate the quality of your school's connection to the Internet.

e) Inadequate. Too slow for instructional use
f) Slow but adequate for instructional use
g) Good. Fine for instructional use

5) How would you rate your computer skills as an administrator?

a) Entry - learning the basics
b) Adoption - beginning to use technology for professional and instructional uses
c) Adaptation- using technology as a tool to accomplish a variety of professional and instructional tasks
d) Appropriation - using technology effortlessly. Explore new and creative uses of technology
e) Invention - developing new learning environments. Learning is collaborative, interactive and customized

6) How would you rate the computer skills of your teachers?

a) Entry - learning the basics
b) Adoption - beginning to use technology for professional and instructional uses
c) Adaptation- using technology as a tool to accomplish a variety of professional and instructional tasks
d) Appropriation - using technology effortlessly. Explore new and creative uses of technology
e) Invention - developing new learning environments. Learning is collaborative, interactive and customized

7) Are you aware of the division wide ACT2 technology plan and your role in that plan?

a) Yes

b) No

8) What percent of the school's budget is allocated to technology?

a) Less than 5%
b) 6-10%
c) 11-20%
d) > 21 %
e) Don't know

9) What percent of your technology budget allocated to professional development?

a) Less than 5%
b) 6-10%
c) 11-20%
d) > 21 %
e) Don't know

10) In your opinion, what percent of students use technology in your school on a weekly basis?

a) 25% or more
b) 50% or more
c) 75% or more
d) 100% of students use technology across all subjects and disciplines

11) How do you/your school communicate with the parents and the community at large?

a) School web page communicates one-way with parents, community
b) Limited access to two-way communications link via email, web tools (e.g., attendance data)
c) Two-way communications to link school, parents, and community, e.g., videoconferencing.
d) Seamless integration of feedback loops among parents, community and school. Parents, community interact to create content with students/Learning at school, and at home occurs seamlessly

Rate your agreement/disagreement with the statements in 12-16 on the accompanying Scantron sheet.

12) I believe that effective use of educational technologies can help improve student achievement.

a) Strongly agree
b) Agree
c) Disagree
d) Strongly disagree

13) The division provides the support you need to help your teachers integrate technology into teaching and learning.

a) Strongly agree
b) Agree
c) Disagree
d) Strongly disagree

14) The school division expects you to continually learn more about technology.

a) Strongly agree
b) Agree
c) Disagree
d) Strongly disagree

15) The technology training available to you is adequate for your needs.

a) Strongly agree
b) Agree
c) Disagree

d) Strongly disagree

16) The pressure to cover content (SOL) prevents your teachers from trying new things with technology.

a) Strongly agree
b) Agree
c) Disagree
d) Strongly disagree

Thank you for your help!!

Figure 2. Teacher Survey

1) How long does it take to receive technical support class/lab?

a) Several days
b) One day
c) Less than 24 hours (same day)
d) Tech support available 24/7

2) In your opinion, what percentage of your students has a computer at home?

a) 76-100
b) 51-75
c) 26-50
d) Less than 25

3) How often do your students use technology in your classroom?

a) NA
b) Seldom
c) Weekly
d) 3-4 times a week
e) Daily; integrated throughout all classes and subjects

4) Please rate your access to the computer lab in your school for instruction.

a) Less than adequate
b) Adequate
c) More than adequate

5) In your opinion, what percentage of your students has a computer with Internet access at home?

a) 76-100
b) 51-75
c) 26-50
d) 25 or less

6) What is the minimum number of networked computers you need in your classroom to use them often for instructional purposes?

a) At least 1
b) 2-5
c) More than 5
d) One for each student

7) Please rate the quality of your school's connection to the Internet.

a) Inadequate. Too slow for instructional use
b) Slow but adequate for instructional use
c) Good. Fine for instructional use

8) How often do your students use drill and practice software in your class/school?

a) Never
b) Monthly
c) Weekly
d) Daily

9) How often do your students use student development software in your class/school (e.g., PowerPoint, Web development tools, KidPix)?

a) Never
b) Monthly
c) Weekly
d) Daily

10) How often do your students use simulation software in your class/school?

a) Never
b) Monthly
c) Weekly
d) Daily

11) How would you rate your computer skills as a teacher?

e) Entry - learning the basics
f) Adoption - beginning to use technology for professional and instructional uses
g) Adaptation- using technology as a tool to accomplish a variety of professional and instructional tasks
h) Appropriation - using technology effortlessly. Explore new and creative uses of technology
a) Invention - developing new learning environments. Learning is collaborative, interactive and customized

12) How would you rate the computer skills of your administrators?

i) Entry - learning the basics
j) Adoption - beginning to use technology for professional and instructional uses
k) Adaptation- using technology as a tool to accomplish a variety of professional and instructional tasks
l) Appropriation - using technology effortlessly. Explore new and creative uses of technology
a) Invention - developing new learning environments. Learning is collaborative, interactive and customized

13) Are you aware of the division-wide ACT2 technology plan and you role in that plan?

a) Yes
b) No

Rate your agreement/disagreement with the following statements.

14) The pressure to cover content (SOL) prevents you from trying new things with technology.

a) Strongly agree
b) Agree
c) Disagree
d) Strongly disagree

15) You receive adequate help in planning and integrating technology into instruction from the technology resource person at your school.

a) Strongly Agree
b) Agree
c) Disagree
d) Strongly disagree

16) Your administrator provides the support you need to integrate technology into teaching and learning.

a) Strongly agree
b) Agree
c) Disagree
d) Strongly disagree

17) The school division provides the support you need to integrate technology into teaching and learning.

a) Strongly agree
b) Agree
c) Disagree
d) Strongly disagree

18) The technology training available to you is adequate for your needs.

a) Strongly agree
b) Agree
c) Disagree
d) Strongly disagree

19) I believe that effective use of educational technologies can help improve student achievement.

a) Strongly agree
b) Agree
c) Disagree
d) Strongly disagree
Thank you for your help!!

Figure 3. Student Survey

1. What grade are you in?

a. 3rd
b. 5th
c. 8th
d. 11th

2. Do the computers in your school work OK?

a. No. Many need to be fixed
b. Yes. Most computers work OK
c. Yes. Almost all computers work OK

3. Do you have a computer at home?

a. No
b. Yes

4. If you have a computer at home, can you get on the Internet from home?

a. No
b. Yes

5. Describe the speed of the computers at school when you are on the Internet.

a. Too slow

b. OK
c. Fast
d. Really fast

6. How often do you work by yourself on a computer at school?

a. Hardly ever
b. Once a month
c. Once a week
d. A couple of times a week
e. Every day

7. How often do you create something at school using a computer (using a program like PowerPoint, Web development tools, or KidPix)?

a. Hardly ever
b. Once a month
c. Once a week
d. A couple of times a week
e. Every day

8. Your teachers like to use technology.

a. Strongly agree
b. Agree
c. Disagree
d. Strongly disagree

9. Do you think that your parents expect you to learn more about technology in school.

a. Yes, definitely
b. Probably
c. Not really
d. I don't know

10. How often do you use computers in school?

a. Every Day
b. A couple of times a week
c. Once a week
d. Once a month
e. Hardly ever
Thank you for your help!!

Figure 4. Interview Questions

1. What is technology integration?
2. What does effective technology integration look like?
3. How do you use computers in your classroom
4. Do you receive adequate professional development?
5. Do you feel empowered to creatively use computers in your classroom?
6. Does the pressure of high stakes tests affect your use of technology (either positively or negatively)?
7. Do you have adequate support to effectively use computers in your classroom?
8. Does Roanoke invest enough resources into technology?

Note. Administrator and school board questions were reworded, e.g., item 3 for administrators, How do your teachers use computers in their classroom?

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