This article serves to provide the framework for understanding the ingredients of successful technology integration in public schools. The "ten button" format of this article is the guiding document for understanding each of the subsequent articles.

TECHNOLOGY LEADERSHIP: Ten Essential Buttons for Understanding Technology Integration in the 21st Century
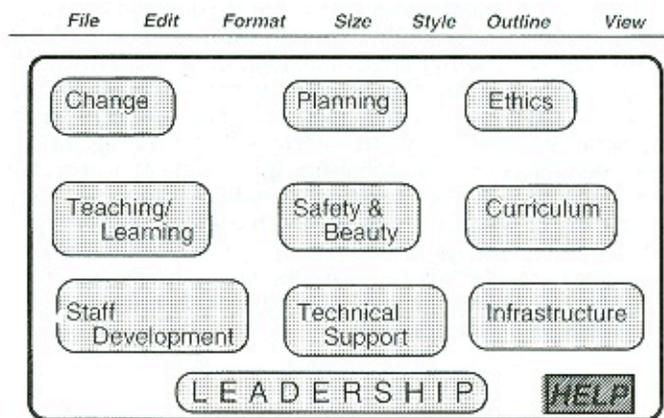
Gerald D. Bailey

There are a small number of administrators who consider themselves technology leaders. Few will admit that they know all there is to know about technology leadership. The quest for understanding technology leadership and technology integration appears to be a lifelong rather than a short journey. Slowly but surely, we are accumulating a critical mass of information which describes the roles and functions of the superintendent, principal, and technology coordinator when weaving technology into the fabric of schools.

Imagine the following: You have been searching for information relating to technology leadership—information which describes what a leader must know to lead schools into the 21st century. In your exhaustive search, you find some soft-

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ware which provides an overview of the role and function of a technology leader. As you load the software, ten buttons pop up on your screen (See Figure One).

Ten Buttons of Technology Integration©
Figure One
Gerald D. Bailey, Kansas State University—Technology Leadership

The "help button" tells you that you are able to begin anywhere in the program because it is a hypertext format. You double click on the leadership button which reveals ten buttons and a set of questions causing you to think about administrators and their role in technology. You begin your search to the illusive question: what does a technology leader need to know?

Button #1: Change

Administrators need a host of skills. One of the most important involves understanding change and the change process. Technology integration at the district, building, and classroom level involves second order changes. You can not bring about massive change if you don't understand the nature of change and the change process.

Before introducing technology into the classroom, the technology leader must have a good grasp of the dynamics of change and how people react to change. Three essential aspects of the change process need to be understood: personal change, organizational change, and cultural change. Fullan reminds us of the following principles related to organizational change: (1) Our version of the change may not be the one most acceptable to those involved, (2) Implementation must be by the participants, (3) Conflict and disagreement are inevitable and fundamental to the process, (4) People need pressure to change, (5) Effective change takes time, (6) There are many reasons that a specific change might fail, (7) Not all or even most of the groups involved will change, (8) You will need a plan, (9) No amount of knowledge will ever make a plan totally clear, and (10) The change process is a frustrating, discouraging business (Fullan, 1991). Second, the technology leader must understand that the concept of change has changed—both in terms of speed and quantity. That is, there needs to be a fundamental understanding of the substantive changes occurring throughout the world which impact on education and much of this change is being driven by technological innovation. Consider the following:

- Every two to three years, the knowledge base doubles.
- Everyday, 7000 scientific and technical articles are published.
- High school graduates have been exposed to more information than their grandparents were in a lifetime.
- There will be as much change in the next three decades as there was in the last three centuries.

- Ninety percent of the technology that you will be using in 2000 has not been invented yet or you don't have access to at this date (McCarthy, 1991).

How well school districts prepare for personal and organizational change has a lot to do with the understanding of the changes that are occurring at a societal level. The degree to which superintendents, principals, and other technology coordinators grasp the underpinnings of change at the micro- and macro-level will have a significant impact on their ability to assume an effective technology leadership role.

Essential questions that need to be asked are:
- Why are change and technology two of the driving forces that will shape our society in the next few decades?
- What are the micro- and macro-characteristics of change that need to be considered when integrating technology?
- What are the implications of the speed of change for technology integration?

Button #2: Technology Planning

The grimmest possible news that a naval captain can receive is that the ship's rudder has been damaged, rendering the ship out of control (Lumley and Bailey, 1993). Like the captain of the *Bismarck* of World War II fame, many district and building administrators find their schools rudderless and out of control in the area of technology planning. School administrators often lead school districts and buildings that have (a) no clear purpose or focus for technology, (b) a wide range of technology abilities among the staff, (c) ill-defined processes of hardware and software acquisition, (d) no centralized procedures for storing and cataloging electronic technology, and (e) limited staff development activities and programs that focus on technology.

Lumley and Bailey (1993) have argued for a systematic approach to technology planning. Pioneering a research and development process with several districts, they developed a six step technology planning model. The six steps include: (1) Organize and empower a District Technology Planning Team, (2) Prepare the planning team, (3) Assess the current state of technology in the District, (4) Develop guiding documents and scenarios, (5) Develop a strategic plan while empowering and empowering building technology planning teams, and (6) Implement and institutionalize the technology plan.

The who, what, where, and how of technology planning continues to be one of the biggest challenges for technology leaders. The use of empowered technology planning teams at the district and building level is an essential ingredient of successful technology leadership. All stakeholders must feel that they are part of the process.

Technology planning needs to be seen as a high priority. The essential questions that need to be asked are:
- What steps are involved in technology planning?
- How is technology planning best accomplished in school districts and buildings?
- Who is responsible for and/or involved in technology planning?
- Why is a technology plan critical for school districts seeking to integrate technology throughout the organization?

Button #3: Ethics

Administrators may not recognize ethics as an immediate need in technology integration efforts. Other educators who have been studying technology have a grasp of the dramatic change that is occurring in society. They readily recognize that ethics will loom larger than almost all other technology-related issues in the next few years.

A recent *Wall Street Journal/NBC* poll indicated that 43 percent of Americans said the country's social and economic problems stem from a decline in moral values. Seventy-five percent of those polled believe that traditional values have grown weaker (Kidder, 1995). What does this have to do with technology integration? It has a lot to do with the speed of change brought on by technology. The pace of change has begun to accelerate exponentially. With the sheer number of inventions, questions have surfaced that would have never arisen in the past.

While many of our traditional values can be stretched to fit the new technology-laden environment, some aspects of this new environment can make the fit difficult to see. A child who would never think of searching through a classmate's desk to read her notes, might feel free to access and read the same classmate's diary stored in a word processing file on a network. A teenager who would never dream of robbing a bank, might experience fewer qualms about attempting to steal funds from the milk account electronically.

These situations will continue to present new problems for teachers, administrators, and school board members. As the number of ethical-related questions increase, a new set of issues need to be addressed in the school curriculum.

Ponder the following questions that Kidder (1995) and other experts are raising about technology and society:
1. How should software be protected from unlicensed copying?
2. Should we ban dashboard radar detectors, whose sole purpose is to help people disobey traffic laws?
3. Should pornography be banned from the Internet? Who should control it, if it is not banned?
4. Can anyone, regardless of age, access sexual explicit text, pictures, graphics, and videos on the Internet?

Technology integration involves more than just teaching students how to use technological tools but the ethical dilemmas which arise when applying the emerging technologies. Technology leaders will need to address the following questions:
- How can the technology leader prepare the school district/building for these critical/controversial issues?
- What are some of the ethical issues that loom on the horizon?
- Where and how should ethical-related issues be dealt with in the curriculum?
- Why must be ethical considerations must be considered a high priority as technology is integrated into the fabric of education?

Button #4: Teaching/Learning

The teaching/learning button may be one of the most significant themes that leaders must consider because it focuses on how students and teachers use the technology in the classroom. Teachers can use technology in three distinct ways: (1) teaching with technology or technology-as-an-aid, (2) teaching about technology or technology-as-subject, and (3) empowering with technology or technology-as-an-empowerment tool. If emerging technologies provide the means for successful school transformation, superintendents, principals, and technology coordinators must provide the leadership and vision for that process to occur.

If superintendents, principals, and technology coordinators are going to be key players in this effort, they must understand the learning choices available in technology-infused classroom environments: technology-as-an-aid, technology-as-subject, or tehnology-as-empowerment.

Technology-as-an-Aid

When teachers teach with technology, traditional subject matter is presented in new and exciting ways by instructors

skilled in using the emerging educational technologies. This view of technology fits well with the Effective Schools Movement. When teaching with technology, instructors use technology to enhance and monitor student learning.

Technology-as-Subject

Teaching about technology is seen in the Tech. Ed. movement and Tech. Prep. movement (new vocational education initiatives). Technology becomes the subject and as well as a tool for studying questions in an applied setting. Few other movements have caused as much excitement or enthusiasm as the Tech. Ed. and Tech. Prep. movements.

Technology-as-an-Empowerment Tool

Empowering with technology means putting technology into the hands of children. Empowering with technology is the process in which the role of the teacher changes from "sage-on-the-stage" to "guide-on-the-side." Learning becomes saturated with technology and students become self-directed learners (Papert, 1980; 1993).

This teaching and learning button deals with how technology is viewed and used in education. The choices of technology-as-aid, technology-as-subject, or technology-as-an-empowerment tool are rapidly becoming a focus of debate in the 1990s. The choices that we make will greatly influence how students will use technology once they graduate and enter the world of work.

Essential questions that technology leaders must ask:
• What technology-based learning methods are finding their way into teaching and learning?
• What is the difference between teaching with, teaching about, and empowering with technology?
• Why have innovative technology-based methods been slow to develop in schools?

Button #5: Safety & Security

Safety deals with how we protect users of the technology. Eye strain and hand/arm injuries have become major problems in other sectors of business. As technology takes on a more integral role in schools, how we protect our students and employees will take on greater significance.

Guidelines will need to be established with regard to VDT safety standards (i.e., minimizing the hazards of video display terminals and issues such as carpal tunnel syndrome caused by repetitive hand motions). Ailments including cysts, inflammation of tendons, and nerve damage accounted for more than half of the 283,700 workplace illnesses in private businesses in 1989. According the U.S. Labor Department, the number of new cumulative trauma or repetitive stress injuries more than doubled between 1989 and 1993, rising from 147,000 to 302,000.

Security has become a major concern as technology has found its way into schools. The larger amounts of hardware and software that are accumulated require administrators to enact measures that protect the investment of the school district in regard to hardware and software. Theft, vandalism, and misuse of equipment can lead to large expenditures for school districts. Policies related to security need to be established for both district and building level operations.

Essential questions that administrators need to ask include the following:
• Why will safety issues become a greater concern to technology leaders in the near future?
• Why are security issues becoming more important to technology leaders?

Button #6: Curriculum

Few issues cause more confusion than how to integrate technology into the curriculum. Too often, curriculum integration is seen as a different issue than technology integration, when in reality, they are inextricably intertwined.

Integrating technology into the curriculum requires inter-disciplinary teamed instruction or in simple language—people teaching together in teams with technology, and this strategy has shown positive results. Interdisciplinary team instruction has positive effects on student performance, motivation, interest, and participation. But the positives are off-set by problems such as loss of individual autonomy.

Teachers need considerable support from colleagues, parents, supervisors, and students when integrating technology. Second, teachers need an adequate budget to support curriculum-technology development. Third, a nurturing work environment that encourages risk-taking, recognition, and rewards is vitally important.

Overall, there are ten major barriers that Bailey, Ross, and Griffin have identified relating to curriculum technology integration (*Catalyst for Change*, 1995):
1. Failure to distinguish the computer from the emerging technologies or learning technologies.
2. Failure to develop a vision of how technology should be used in all aspects of teaching and learning.
3. Failure to prepare and implement district and site technology plans as prerequisites to any curriculum-technology integration activities.
4. Failure to design and implement a technology staff development program as a prerequisite to curriculum-technology integration activities.
5. Seeing technology integration from "traditional" curriculum leadership perspective.
6. Failure to understand the basic differences between informational literacy and basic literacy.
7. Failure to understand that the emerging technologies hardware and software (videodiscs, CD-ROMs, etc.) as well as the information on the Internet represents the most comprehensive, valuable set of curriculum materials ever available to humankind.
8. Failure to empower students and teachers to engage in risk-taking and experimentation with the emerging technologies.
9. Failure to see the curriculum as something more than the written word or text.
10. Failure to integrate technology into basic learning processes—both outside and inside the classroom.

Tackling curriculum-technology integration is one of the toughest issues facing administrators. Essentially, the major questions to be asked include:
• What is the relationship between technology and curriculum?
• What is the role and function of technology in curriculum development?
• Should technology support the existing curriculum? or should technology be used to transform the curriculum? relationships?

Button #7: Staff Development

Creating a technology staff development program is similar to the early American pioneers who charted unknown territory. In the early exploration period, there were no maps which showed rivers, mountains, and canyons. To find their way, early travelers used crude, unreliable maps and a compass.

Administrators engaged in creating technology staff development programs are similar to Lewis and Clark who searched for an inland water route across the United States to the Pacific Ocean. Lewis and Clark used existing maps but also drew new maps that were more detailed about "known land." The technology leader must use old staff development maps but continuously create new technology staff development maps for others to follow.

For the busy administrator, there is good news and bad news related to previous technology staff development efforts.

The good news is:

1. There is a body of existing literature which describes effective practices of staff development programs which has been accumulating over the last several decades.
2. The popular literature identifies beginning success stories (best practice) of technology staff development programs.
3. The field of educational computing is more than thirty years old and includes considerable research about computer-related learning.
4. The literature confirms that the role of the administrator is crucial in school improvement activities.

The bad news is:

1. Even though there is considerable information about the general characteristics of effective staff development practices, there have been minimal amounts of information specific to technology staff development programs.
2. Few, if any, technology staff development program models have been field-tested by researchers.
3. Even though we have an abundance of research related to computer learning, little information exists about student learning with the emerging technologies (e.g., multimedia, electronic collaborative learning, electronic cooperative learning).
4. While the role of the administrator has been highly touted as significant in school improvement activities, little or no information exists which describes the specific roles and responsibilities of the administrator as a technology leader who is involved with restructuring schools with emerging technologies.

While most technology staff development programs are in their infancy, Bailey and Lumley (1994) have outlined a four stage process for creating technology staff development programs. They include: (1) prepare for change, (2) plan your technology staff development program, (3) implement you staff development program, and (4) institutionalize your staff development program. This new technology staff development map holds out new promise to technology leaders.

The following questions are the basic guideposts for thinking about technology staff development.

(1) What kind of technology staff development program is necessary to integrate technology into the educational structure?
(2) How does a technology staff development program fit with other staff development efforts and school improvement?
(3) Who are the audiences in a technology staff development program?

Button #8: Infrastructure

Infrastructure has to do with the facilities—the use of technology in the existing facilities as well as building new facilities to accommodate new ways of using technology. Too few people understand the infrastructure theme well enough to ask the right questions. Technology leaders must join hands with architects to determine the right questions that must be posed. Baseline questions must begin with the following areas: space, wiring, security, lighting, furniture, shielding, and acoustics.

Practitioners need to be able to understand the infrastructure button well to find out new ways of looking at the physical environment needed for new styles of learning.

- Why are physical facilities critical to seeing the "total picture" of technology leadership?
- What must technology leaders recognize and understand about the infrastructure?
- Are technology-related infrastructure issues the same for all leaders in all situations—using existing facilities and creating new facilities?

Button #9: Technical Support

Technology support can be defined as those personnel who serve as the technology coordinator, the technician who repairs the equipment, and the people who serve in an assistive roles to those people using technology. All three of these technical support categories represent people who are critical players in technical integration at the district and building level.

Teachers and staff who use technology need to feel that the equipment requires little preparation or knowledge for initial operation. This phenomenon of "anxiety-free" interaction with equipment is sometimes called "plug 'n play." Without this prerequisite condition of plug 'n play, few teachers have been able to effectively integrate technology into their teaching. Simple operation of the equipment remains a hallmark of most successful technology integration programs, and when this does not occur, teachers retreat from the equipment and return to what they know best—"teacher talk and text."

"Hot-line help" is the companion feature of a plug 'n play technology-infused culture. Teachers and staff need access to someone that can understands them as much as they understand the equipment. Making help available to participants when they have questions or need assistance is a critical dimension of successful technology integration. Participants can have a high degree of motivation about the technology, but if no one is around to answer or assist when actual use of the technology begins, motivation plummets in one or two small misadventures.

The following questions relate to the button of technology support:

- Who and what is necessary to allow technology integration to operate smoothly?
- Why is plug 'n play and hotline help crucial to effective technology integration programs?
- Is maintenance and repair in technology integration programs important? Why?

Button #10: Technology Leadership

Technology leaders are those who see technology as a central tool for transforming teaching and learning. Technology leadership embodies all ten buttons and more buttons that are yet to be discovered and refined.

Bailey & Lumley (1995) have argued that technology leaders have to possess several skills. They include: (1) technology skills—leaders must be able to model the technology, (2) people skills—leaders must be able to get along with other people as we learn to use the new technologies, (3) curriculum skills—leaders must understand how to integrate the technology into all disciplines, (4) staff development skills—leaders must understand the important of training to those people using the technology, (5) learning leadership—leaders must understand the "big picture" (systems thinking) as they work with others to use technology to transform teaching and learning.

The following questions should point the way for additional discussions on technology leadership:

- Can/must a technology leader master all of the leadership buttons?

- Is there a sequence to studying and mastering these technology leadership skills?
- How does a technology leader acquire these skills?

Do I Need to Master All Ten Buttons?

Becoming aware and familiar with all of the ten buttons is a more realistic approach to technology leadership rather than trying to master all ten buttons. Technology leaders must recognize that all ten buttons need to be considered as they integrate technology into the fabric of education. They must collaborate with other people that have expertise in each of the buttons. Technology integration is a team approach and no one individual can know all or master all buttons in a school district or building. The key to effective technology leadership includes:

1. Empowering team members so they recognize the systemic nature of technology integration.
2. Identifying which of the buttons to address along the journey of technology integration.
3. Understanding the interconnectedness and complexity of the buttons. In other words, one button cannot be dealt with without influencing and impacting the other buttons.

By keeping the ten buttons in a hypertext metaphor, the technology leader is able to step back from day-to-day operation to determine how to orchestrate the transformation process that must take place to create 21st century learning environments.

Conclusion

The ten buttons of technology leadership are in the process of uneven evolution. Some buttons may be combined while others may be expanded into new areas that are not totally clear at this time. Undoubtedly, technology leaders will make mistakes and will travel unnecessary paths as they search for these buttons, and they will bear the torments and taunts of those who think that technology is robbing us of our humanity. The technology leader of the 21st century education will need to be as brave and courageous as any leader that we have seen in recent history.

We need to remember the words of John F. Kennedy . . . "when written in Chinese, the word "crisis" is composed of two characters—the one represents danger and the other represents opportunity." The essential question is "will you spend the majority of your time helping others look for the opportunities of technology or the dangers of technology?" The survival of our youth, public education, and our nation depends on your response.

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