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Preface

Technology integration is one of the most important issues facing schools in the 1990s. Without clear resolution of the issues surrounding the implementation of information technology in educational environments school reform efforts are seriously hindered and unconnected to changes occurring in the rest of the world. Too often information technology issues have been the purview of technology gurus and not become an integrated part of the redesign of public education. Few researchers or practitioners have provided a clear, detailed picture of the technology leadership. This issue of *Educational Considerations* attempts to create the first systems picture of technology leadership and provide glimpses of resolution strategies for the difficult work ahead.

The editors wish to thank several people for their assistance in creating this issue of *Educational Considerations*. The authors wish to thank David Thompson for inviting us to participate in this project. Second, we wish to thank Dr. Gwen Bailey for providing valuable editorial assistance. Third, we wish to thank all the contributors who took their valuable time to contribute to this special issue on technology leadership.

We hope that this is the beginning of a sustained dialogue concerning technology integration and the role of school leaders.

Gerald D. Bailey and Tweed W. Ross, Guest Co-editors
March 1996

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.

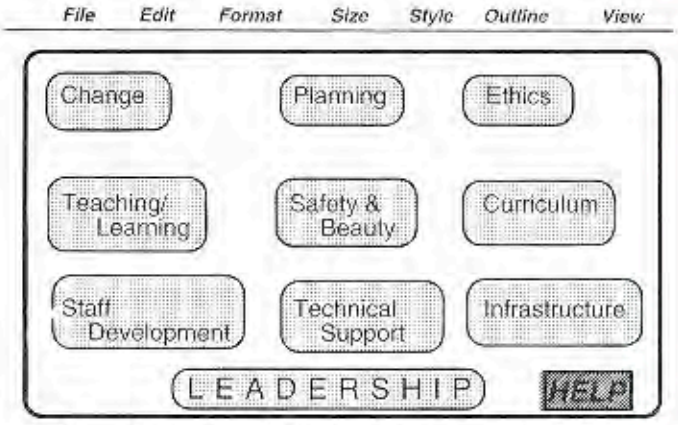
TECHNOLOGY LEADERSHIP: Ten Essential Buttons for Understanding Technology Integration in the 21st Century

Gerald D. Bailey

Special Note: The author is grateful to the contributions of Dan Lumley and Tweed Ross for assisting the author in refining ideas expressed in this paper. Without their visionary view of education and synergistic personalities, this document would not have been possible. Also, the author wishes to thank countless principals, superintendents, and technology coordinators who have assisted me in developing the ten buttons of technology leadership.

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 software 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.

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- 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 interdisciplinary 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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Planning for technology is a crucial component of success in integrating technology into school environments. A six step outline is provided to help school administrators through this complex, critical process.

Technology Planning

Deborah S. Dunbar

While the promise of technology generates excitement and enthusiasm among educators, we are all aware of countless stories about the difficulty of implementing broad-based technology programs into our schools. Stories of outdated equipment stockpiled in closets, inadequate staff training, a lack of technical support, and disillusioned teachers and administrators are common. Whether schools are urban or rural, public or private, when it comes to technology one thing is certain: it is essential to have a vision and a strategic plan for turning that vision into reality.

Why plan for technology?

Strategic planning means skillful planning. It means integrating short-term plans with long-term objectives. It means putting your school district in its most advantageous position for achieving overall results. Strategic planning is a process for answering three basic questions: Where do you want to go? How are you going to get there? and How will you know when you've arrived?

Many technology plans focus on hardware and software selection and fail to present a strategic, comprehensive view of the technology-supported transformation of teaching and learning. Thus, a technology plan must be closely aligned with an overall strategic plan for the school district. This allows specific action plans to be developed annually that fit with the strategic direction of the organization.

Philip J. Brody (1995) emphasizes that it is important to understand the four basic principles listed below, as they directly or indirectly color virtually every element related to technology planning:

1. A technology plan must meet the needs of the school district, not the planner. Too often, we lose sight of this, charging ahead, oblivious to the needs the plan must meet.
2. Planning may be a useful exercise in many respects, but unless it leads to concrete action, it will remain just that—an exercise.
3. A plan must be more than a wish list or an opportunity to demonstrate one's cleverness and ingenuity. Although such an approach may impress some, plans that do not accurately assess and take into account the realities, strengths, and limitations of the environment rarely succeed.
4. It is easier to make basic changes and adaptations early in the planning process, before individuals or groups have become committed to a particular course of action.

Strategic planning for technology sets program performance goals and evaluation criteria. It guides the activities and relationships among personnel. It establishes a shared vision of what the school district ought to be doing and how it will carry out its mission.

What is involved in the process of technology planning?

Lumley and Bailey (1994) have developed a practical yet powerful model for use in the technology planning process. Their six-step model guides a district team through well-organized steps for planning:

Step 1: Organizing and Empowering a District Technology Planning Team

This step offers suggestions and tips for identifying and training the school district technology planning team. Since many instructional and administrative issues will be dealt with, they recommend that a broad cross section of people be represented on the planning team. Teachers, administrators, parents, business and industry representatives, community members, school support staff are all potentially valuable members of a district planning team.

Step 2: Prepare the Planning Team for the Study

Lumley and Bailey suggest that in order for school district technology planning teams to make informed and wise decisions, professional development is necessary for all players. Team members must become familiar with basic terminology, emerging technologies, and appropriate applications for schools.

Step 3: Assessing Current State of Technology in District

The third step for the planning committee involves conducting needs assessments or audits that pull together all current technology information in the district at the present time. What technologies are currently being used? What hardware and software are available? What are the current staff development needs? What opportunities are being provided?

Step 4: Develop Guiding Documents for Technology

Three guiding documents form the starting point for a technology plan:

* A philosophy statement	identifies ideas, values, opinions
* A mission statement	encapsulates the longer philosophy statement; communicates to all publics about the potential of technology and learning
* Series of technology	identifies desired student goal statements outcomes

Step 5: Develop the Long-Range Technology Plan

Lumley and Bailey indicate that developing the long-range technology plan comprises the major task of the planning team in terms of time and effort. Generally speaking, the final plan will facilitate the organization of the district's human, material, time, physical, and financial resources and provide a focus and direction for all stake holders in the district.

Step 6: Implement and Institutionalize the Technology Plan

Elements of this step include the approval of the technology plan by the school board, and implementation of ongoing activities that involve district staff, parents, students, business and community members.

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What happens after the plan is adopted?

The long-term health of a district's technology plan will never be secured through a day-at-a-time administration. There must be an overall, ongoing process whereby the plan is monitored, updated, and adjusted to reflect changes in the operating environment. A technology plan is no guarantee of success or organizational well-being, but without one, well-being will surely elude even the most well intentioned school district.

What are the elements of a broad-based comprehensive technology plan?

The following checklist may be helpful in providing a road map to the items that should be included in a school district's technology plan:

Guiding documents: Philosophy, Mission, and Goal Statements

Documentation linking the technology plan with the district's overall strategic plan

Action plans:

1. Equipment/Infrastructure
   - *network design
   - *hardware
   - *electronic mail
   - *telecommunications/ Internet access
   - *interactive television
   - *satellite
   - *phone system/fax
2. Administrative Applications
   - *information processing
   - *student information financial management
   - *personnel management
   - *inventory and fixed assets
   - *food services
   - *transportation
   - *special education
3. Curriculum Development/ Instructional Management
   - *curriculum database
   - *learning management
   - *instructional resources
   - *test item banks
   - *testing management
   - *statistical data analysis
4. Library/Media
   - *online services for students
   - *CD ROM reference materials
   - *acquisitions cataloging
   - *circulation
   - *information referral file
   - *online catalog
   - *serial control
5. Staff Development
   - *awareness
   - *basic skills
   - *district standards
   - *integrating technology into curriculum
6. Technical Support
   - *building-level support
   - *district-wide troubleshooting
   - *maintenance contracts
   - *in-house repairs/vendor repairs
7. Funding Sources/ Technology Budget
   - *district commitment
   - *building/site-based funds
   - *federal sources
   - *state sources
   - *local sources
8. Communications & Public Relations
   - *community outreach
   - *media plan
   - *building-level activities/ demonstrations
9. Evaluation/Review of Plan
   - *continuous assessment & monitoring
   - *annual review and update

A strategic plan for technology should be based on the fiscal and systemic realities of each school district, rather than serving as a dream list of wants and perceived needs. A district leadership team should continuously monitor implementation, assigning action plan tasks broadly across the district to ensure a shared step-by-step approach. Teachers, administrators, students, parents, and members of the business community should all participate in both the planning and implementation process. Technology planning is not a process to be left in the hands of a few top managers, but needs to be done on a systemic, district-wide basis. Together, stake holders can work for continuous quality improvement of the school district . . . successful integration of technology plays a key role.

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Staff development for technology is the "Achilles heel" of information technology integration. Too often school leaders presume that if the only get the right equipment, right software, right curriculum the program will fall into place. Research and practice have consistently documented that without effective technology staff development spearheaded by competent educational leadership, that vast investment in equipment and software is wasted. This article provides strategies to implement a technology staff development program.

CREATING TECHNOLOGY STAFF DEVELOPMENT PROGRAMS: A Leadership Perspective

Dan Lumley and Gerald D. Bailey

Everywhere one looks, technology is changing the way we work and live. Everywhere, that is, but in our classrooms. It is clear that schools have failed to join the information revolution that has so profoundly effected other sectors of our society. Schools are in a precarious position because they have not kept pace with technology.

In an information age society we have factory-era schools. In classrooms that could be modern communication centers of learning, the basic media of instruction continues to be chalk boards, teacher talk, and textbooks. While the military, businesses, medicine and science have undergone a technological metamorphosis, education is mired in 19th century curriculum and instruction. If Horace Mann were to walk the halls of a twentieth century school, he would feel at home among the paper, pencils, chalkboards, and textbooks. He would quickly recognize bored students recalling facts from short-term memory, a curriculum segregated into separate subjects, standardized tests, and teachers being "a sage on the stage" pouring facts into empty vessels. On the other hand, if Horace Mann were to visit a modern factory or hospital, he would feel lost among workers using computers, voice mail, E-mail and Fax machines. In short, education is not "plugged in" to the Information Age.

Many schools aren't participating in the information age because of a lack of staff development in the area of technology. Unfortunately, it is commonplace for school districts throughout the nation to have limited technology-related staff development activities and programs. In May, 1995, *Electronic Learning* surveyed on the nation's schools. They found that 28% of respondents did not spend a single penny on technology-related staff development while the remainder spent less than ten per cent of their staff development budgets on technology.

Some insist that human problems related to introducing technology in the schools are far greater than technical ones. Technology is evolving faster than humans can learn how to use it which has big impact on the culture of the school. This rapid change often leaves educators feeling helpless and bewildered. The fear of technology held by rank and file teachers looms as a significant barrier to successful integration of technology in the schools.

Teachers are key players in the development and implementation of a technology program. They must feel safe to learn and grow in the area of technology. Teacher training in the area of technology assumes a pivotal role in the restructuring of education. People are the most valuable resource when planning for technology and we must invest in them. Simply stated, if successful integration is to take place teachers cannot be passive spectators of technology.

School reformers routinely talk about developing an information-age learning patterns. The problem is that many educators are unfamiliar with what information-age learning looks like. Below are five characteristics which earmark information-age learning:

1. **Time**—people can learn anytime; learning is not confined to time the learner spends in school.
2. **Place**—people can learn anyplace including home, work, school, play, etc.; schools are no longer the learn forum.
3. **Form**—people can access more information from electronic sources; information-age learning does not do away with printed word but is enhanced by using many formats including: graphics, sound, and video.
4. **People**—all stakeholders are seen as learners; students, parents, teachers, administrators, business & industry, and lay citizens are all seen as life-long learners as well as co-teachers of each other.
5. **Knowledge**—knowledge in the information-age is not seen as the same kind of knowledge needed in the industrial era; basic literacy found in the industrial-era is important but information literacy is critical in the information-age; the learner sifts through data to create information; information is used to create knowledge; mastery of information literacy involves accessing, analyzing, applying, and creating information; information literacy is viewed and measured through a lens of multiple intelligences with group and individual performance orientation rather than paper-and-pencil tests.

Busy school leaders often search for help in planning for the technology staff development that is urgently needed to transform schools to the information-age learning model. Leaders must begin the planning process by (1) reviewing characteristics of effective staff development programs, (2) determining staff development areas that will receive the greatest focus, and (3) explore the different staff development audiences that will be addressed.

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Twenty-Two Characteristics of Effective Staff Development Programs

There is a body of existing literature which describes effective characteristics of staff development programs which has proven to be crucial in school improvement efforts. These characteristics furnish "snapshots" of what researchers and practitioners have found from past research and "best practices" in the general area of staff development, computer-assisted instruction, and research related to using emerging technologies for instructional purposes.

1. Leadership Commitment and Support

Commitment and support from district (i.e., central office and board of education) and building administrators are prerequisites to effective technology staff development programs. These leaders exhibit initiative, expertise, and concern for others.

2. Comprehensive, Continuous, and Evolutionary Programs

Technology staff development programs are comprehensive in nature; that is, they deal with more than the operation of technology or technical skills. They include training about how to integrate technology into teaching and learning over extended periods of time. There are follow-up activities which monitor progress and build on initial training. The program is open and flexible to allow new developments in the emerging technologies as well as how to use these emerging technologies in technology-infused environments (i.e., access to many different emerging technologies).

3. Preservice and Inservice Connection

The technology training received in preservice and inservice are well connected and coordinated.

4. Restructure or Transformation Focus in a School Improvement Context

A comprehensive technology staff development program focuses on restructuring or transforming education through school improvement. Personal development is seen within the context of school improvement.

5. Partnership Foundation

A comprehensive technology staff development program is a partnership between and among schools, parents, universities, and business and industry.

6. Multiple Participant Incentives

Participants have incentives to participate in technology training such as release time, inservice days, public acknowledgement, stipends, college or district credits, awards, etc.

7. Participant Involvement

Participants receiving technology training are involved in the decision-making process which shapes and molds the staff development program. Meetings are held to deal with teacher concerns and consensus building around the school improvement effort.

8. Recognition

Participants receive recognition for their participation and achievements from a variety of sources: peers, supervisors, parents, school board, and community.

9. The Principal as Learning Leader

The principal is key player in the technology staff development program. The principal supports and advances technology training in a variety of ways: (a) models or uses technology in day-to-day management and learning activities, (b) promotes technology as a key restructuring and/or transforming tool, (c) recognizes and maximizes staff development opportunities for unlocking the power of the emerging technologies, and (d) participates in the staff development training activities.

10. Governing Documents

The technology training program is guided by a vision and set of core values (i.e., mission statement and goal statements) which are embodied in a variety of belief and policy statements. Governing documents speak directly to leadership, governance, budget considerations, program, and participant accountability. The governing documents provide a legacy for a continuous and uninterrupted, technology staff development program even during changes in administrative leadership at the building and central office level.

11. District and Building Perspective

The technology staff development program promotes a coordinated effort between district and buildings while demonstrating an understanding of technology's growing role in a global society. The technology needs of the district are met as well as the unique needs of teachers, parents, and administrators.

12. Adult Learning Principles and Professionalism

The nature of the technology staff development program recognizes and capitalizes on the learning styles of adults as well as needed training for on-going skill development or continuous growth.

13. Mandatory vs. Voluntary Involvement, Flexible Scheduling, and Options

Participation in school improvement is mandatory but participation in all technology staff development activities is not mandatory. In other words, the technology staff development program provides much flexibility to participants in terms of scheduling and options. While there is flexibility, participants need to recognize that professionalism demands a high degree of commitment.

14. Use of Effective Trainers and Presenters

The technology training program utilizes expertise both outside and inside the system. All trainers and presenters model effective use of the emerging technologies and have credibility with participants.

15. Effective Training Practices

The entire technology training program is based on effective training elements which are linked to everyday practices. That is, the training is connected to what people do on a daily basis. Teachers must see a direct connection to their world. Participants are expected to practice new behaviors in their workplace. Training includes an explanation of the theory, multiple demonstrations of processes and content to be mastered, and opportunities to practice with factual non-evaluative feedback and coaching. Follow-up training is a hallmark of these training cycles.

16. Conducive Learning Environment

The training program is conducted in a positive learning environment within and outside the classroom (e.g., appropriate seating, lighting, wall color, space, etc.).

17. Best Practices and Relevant Research

While the technology training program acknowledges and uses effective school research and teacher effects research (traditional educational research), it relies heavily on "best

practices" (anecdotal information) and research and development (R&D). Technology staff development activities and programs are selected on the basis of "breaking the mold of traditional teaching and learning with technology" rather than selecting "this year's new thing."

18. Risk Taking and Experimentation

The technology training program promotes risk taking and experimentation by all stakeholders—teachers, administrators, parents, business & industry, and trainers. Participants are encouraged to play with the emerging technologies (i.e., a blurring between fun and work) and using the emerging technologies to redefine teaching and learning.

19. Program Material Characteristics

Materials which facilitate participant training activities and outcomes are readily accessible and assist participants when direct, personal contact with trainers is impossible or inconvenient. These technology training materials are clear, detailed, and sequenced to match participant interest and skill level.

20. Meets Individual Needs

Programs and activities are geared to meet needs and interests of participants. Interests and skills range widely: nonusers (technophobes and those who do not have access to technology), moderate users, to high-end users (technophiles).

21. Accountability

Program evaluation includes both formative and summative measures. Participant evaluation is based on more than participant performance (classroom or school performance) and student achievement (i.e., norm-referenced and standardized tests). Program effectiveness is determined by multiple criteria and standards reflective of our Information-Age (i.e., authentic assessment, electronic portfolios, world-of-work competencies). In short, 21st century standards should be applied when evaluating the program rather than 19th century standards.

22. Cooperative Work Relationships.

Participants work with and learn from each other in training sessions. They are rarely isolated or required to work independently since team relationships are paramount to redefining teaching and learning—the essence of school transformation.

There are many components of an effective technology staff development program. While no single program has all of these characteristics, effective technology staff development programs have many of these characteristics in common. When developing an effective technology staff development program, school leaders should draw on these characteristics to shape and structure the program.

Four Staff Development Initiatives That Should be Addressed

School leaders often struggle with where to begin in technology training and what areas should receive the greatest focus. Leaders should begin by viewing training through a district-wide lens at four major technology initiatives (program offerings). These initiatives represent critical areas of focus when integrating technology into education and include: (1) administrative productivity, (2) curriculum production, (3) teaching & learning, and (4) school restructuring/transformation. The following definitions provide a more detailed explanation of the four district-wide initiatives:

1. **Administrative Productivity**—*organization and individual efficiency through technology.* Participants use the emerging technologies to enhance or transform the following processes: (1) communication, (2) budget or purchasing, (3) record keeping, (4) personnel, inventory, (5) transportation management, and (6) food management. Remember that administrative productivity is designated for all program participants—not just administrators (e.g., teacher productivity by using electronic grade reporting).
2. **Curriculum Production**—*creation and modification of learning materials.* Participants use the emerging technologies to enhance or transform the following processes: (1) technology-based curriculum review (i.e., selection of software, databases), (2) technology-based curriculum development (i.e., creating products using technology tools and applications), (3) technology-infused environments (i.e., massing the use of emerging technologies in one location for multiple users), (4) library automation, (5) curriculum resources (guide) development (i.e., creating electronic curriculum access), and (6) school improvement research (i.e., collecting and analyzing data electronically).
3. **Teaching & Learning**—*process of redefining role of teacher and student where teachers are facilitators of students who are actively engaged in functional literacy as well as information literacy learning.* Teachers and administrators explore the following transformation concepts as they use the emerging technologies: (1) guide-on-side, mentor, co-learner, evaluator and co-evaluator, and learning leader. (2) student learns with teacher by focusing on functional literacy concepts (academic basic skills), emerging technology skills, technology-based learning methods (e.g., electronic cooperative learning, electronic collaborative learning, multimedia, distance learning, virtual reality, and (3) information literacy (i.e., accessing analyzing, applying, and creating information electronically).
4. **School Transformation**—*fundamental or radical redesign of teaching and learning which addresses the underlying causes, rather than the symptoms, of low quality education.* Participants explore the form and function of schools, teachers, and students. Education is redefined with the emerging technologies. For many technology visionaries, this initiative is synonymous with "anyone learning anything, in any form, anytime, anyplace."

In effective technology staff development programs, the four initiatives are always **balanced or rotated**. That is, each of the four initiatives are explored in significant depth. Some schools will deal with these initiatives simultaneously while other schools will concentrate on one initiative before moving to the next.

All technology staff development programs are not well balanced. Due to lack of insight or proper planning, many schools often allow dominance of technology basic skills or one program initiative dominating all other program initiatives.

After the decision has been made as to which district initiative should receive immediate attention, school leaders should aggressively plan for teacher training sessions on basic technology skills.

Basic Technology Skills

It is important to remember that basic technology skills embraces all emerging technologies—not just computers. Basic technology skills training can be organized into six discrete categories. They include: (1) computer operation and word processing, (2) emerging technologies, (3) spreadsheet construction, (4) data base construction, (5) networking, and (6) visual–audio data processing (e.g., graphics, video, sound).

The following definitions provide a detailed explanation of the basic technology skills which need to be offered in a training program:

1) *computer operation and word processing*—skills related to turning computer on and off, printing, routine procedures of computer navigation, etc. as well as the art of entering text and manipulating text-based documents. This competency can be described in terms of a users's ability to "crunch words."
2) *emerging technologies*—skills (in addition to the computer) which involve the operation of interactive videodisc player, modem, videotape recorder, audiotape recorder, television, FAX, CD-ROM (compact disc read only memory), satellite, LCD panel (liquid crystal display). This competency can be described in terms of a users's ability to "navigate electronically."
3) *spreadsheet construction*—skills related organization of numerical information into ledger-like electronic forms for analysis and calculation. This competency can be described in terms of the user's ability to "crunch numbers."
4) *database construction*—skills related to the construction of an aggregation of data together with a collection of operations that facilitates searching, sorting, and recombining activities. This competency can be described in terms of a users's ability to "crunch data."
5) *networking*—skills related to communication with others on computer network, and connection of teachers to major databases inside and outside the school. This competency can be described in terms of a user's ability to "communicate electronically over distance and time."
6) *visual–audio data processing*—skills related to using sound, video, graphics, text etc. (i.e., HyperCard™, HyperStudio™, LinkWay Live™). This competency can be described in terms of a user's ability to "crunch pictures, sound and text."

As these programs are offered, technology leaders need to remember that program participants may already have these skills. Participants should be offered training in technology basic skills **only as long as an individual or program needs exist**. All participants need to have a working knowledge of the basic skills before becoming heavily involved in the technology program initiatives which represent the rooms found in the technology staff development program.

After school leaders have examined characteristics of effective staff development and begun identifying which program area(s) to focus on first, they should decide how much of the technology staff development program should be dedicated to the classroom teacher as opposed to other audiences such as administrators, school board, and support staff, etc.

Identifying the Audiences for Staff Development

An effective technology staff development program has many different audiences. In an ideal sense, classroom teachers, administrators, board of education members, substitute teachers, support staff, and parents should be targeted for the technology staff development program. In practice, however, teachers are usually the primary participants in the technology staff development program. This "practical mind set" of seeing teachers as the primary target is what most of us bring to technology staff development programs.

Typically, we think the teacher is the only person that impacts learning is classroom teachers. However, we know from personal experience and research literature that many other individuals (e.g., administrators, cooks, janitors, parents, siblings) play key roles in student learning. It is all of the stakeholders in the school district or building that impact student learning!

Let's take a look at some of the key players that should be considered when building a technology staff development program:

Superintendent

Most agree that the superintendent is and should be a key player in transforming education through the emerging technologies. Yet, most of us hesitate to include this individual in the technology staff development program.

The presence and participation of the superintendent in technology staff development activities sends a strong message to all other stakeholders. Yet, effective superintendents have always attended staff development programs. This is especially true for technology staff development programs since the superintendent is or should be the primary visionary of the program.

School Board Member

Few technology staff development programs make formal provisions for school board members under the district's staff development umbrella. However, in most successful technology staff development programs, the school leaders have included, updated, or communicated with the board of education at critical junctures in the program.

Staff development opportunities must be made available to board members to insure that they are prepared to carry out their responsibilities as leaders in the school district.

Building Level Administrator

The building principal is a key player in school transformation process. Without doubt, he or she is a key person in making change happen at the building level. But like the superintendent, most of us would hesitate to make substantive provisions for this individual in the technology staff development program. The fact remains that the presence and leadership of the building principal is critical to any staff development program.

Parents

Traditionally, staff development programs have been designed for one group of individuals—teachers. Ask any teacher who has the most influence on students as a learners and that teacher will tell you—parents. Parents are crucial to the support necessary for their children's understanding of technology-based learning. Further, without effect staff development for information technology parents are likely to retreat to the education they understand—one driven by available technologies when they attended school.

Support Staff

Typically, support staff such as secretaries, bus drivers, custodians, cooks are the last group of people we would think of as primary stakeholders in the technology staff development program. Yet, personal experience and research tell us that these are key people in the success of an educational program.

For example, how many stories have you heard about the custodian who either "made or broke" an innovative project by the way the chairs or room were arranged? For a second example, consider who a community member makes contact within the district or school if they have a question about what is going on in the school. Do they go to the superintendent, principal, or teachers, or do they communicate with support staff? Our experiences tell us that they communicate with support staff because community members feel more comfort with people who are like them. We believe support staff are **key** individuals in a technology staff development program.

Library Media Specialist

The library media specialist plays a primary role in the technology staff development program. The media/library specialist's role, needs, and expertise should be carefully integrated into the technology staff development program.

Classroom Teachers

After considering the previous stakeholders, the primary players can and should be considered—**the classroom teacher.** The primary purpose of considering the previous groups is to recognize that the classroom teacher is not the sole person responsible for learning in the classroom. Yet, it is equally important to recognize that the teacher's success is dependent on the stakeholders found in any school district or building.

Summary

Creating a technology staff development program is not an easy task. Understanding the characteristics of effective staff development programs, determining staff development priorities, and targeting different audiences are three critical steps found in technology staff development leadership. Change is gradual and difficult process and can never be considered a one-time event. Constructing a technology staff development programs is similar to the early American pioneers who charted unknown territory. They relied on existing maps but were not afraid to create new maps. Modern school leaders who design technology staff development programs, like their ancestors, are truly first-wave pioneers.

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Many barriers have been placed in the path of school curriculum reform involving technology. This article focuses on eleven of these barriers and provides workable recommendations for ameliorating them.

Barriers to Curriculum-Technology Integration in Education

Gerald D. Bailey, Tweed Ross and David L. Griffin Sr.

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Barriers to Curriculum-Technology Integration in Education—Are You Asking the Right Questions?

A survey 1988 of school districts across American highlighted numerous success stories about integrating technology into the fabric of teaching and learning (OTA). A follow up study by the Office of Technology Assessment reiterated the same heroic theme, but emphasized a growing concern about the lack of wide-scale adoption of technology into classrooms (1995). Numerous heroic efforts of teachers empowering students with the new technologies vital to human survival in the evolving global economy have been documented (*Business Week*, 1994). Yet it still takes heroic efforts. A central question remains. Why, after several years of heroic efforts and vast sums of money, is the integration of technology into curriculum still dependent on individual heroic efforts?

Individual success stories and heroic efforts of technology are not enough to meet the challenges of preparing students for the 21st century. National, state and local agencies, which govern public school systems throughout the fifty states, must make technology integration their top educational priority in the next decade. Failure to do so is to put our nation at risk of losing the economic, political, and social leadership position that it has held in the last century.

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Why Are We in Technology-Integration Limbo?

American schools have not embraced technology as a major school transformation tool for a variety of reasons. Lack of leadership within their own ranks, lack of state and national government support, lack of staff development, and lack of money are a few reasons which can be attributed to our current state of "technology-integration limbo."

Fundamentally, lack of systematic technology-integration in American education can be attributed to educators' failure to understand the impact that technology has had on society over the last few decades. Educational leaders at all levels have failed to see the emerging technologies as a second order change referred to by Larry Cuban (1992). In essence, the emerging technologies in business, medicine, military, agriculture, entertainment, religion, etc. have changed the way we communicate, work, play, and make a living in society. Students swim like fish in a sea of technology until they pass through the school door where they become goldfish in a fishbowl. The school landscape is littered with unused technology which failed to be integrated into a meaningful curriculum (Borrell, 1992). One can safely argue that the last sector of society that remains "unwired and unchanged" is public education.

Where Are We?

The heroic efforts of curriculum-technology integration taking place today in schools throughout the United States could be described as "piece-meal" at best. In the last decade, we have argued that a number of leadership strategies must be undertaken to effectively integrate technology into teaching and learning. Strategies such as technology planning (Lumley & Bailey, 1993), technology staff development (Bailey and Lumley, 1994), and technology leadership (Bailey & Bailey, 1994) must become priorities before moving into major curriculum-technology integration efforts.

During this period of time, few materials have surfaced on curriculum-technology integration as a natural flow of the total process of technology planning. This is not to say that computers have not found their way into the curriculum or are nonexistent in the school curriculum. Millions of computers and computer-related devices have been purchased by elementary and secondary schools over the past ten years, but technology remains a curriculum "add on" to a curriculum already overloaded with public agendas.

What Are the Right Questions?

Curriculum-technology integration is complex. The complexity lies in asking the right questions—*not necessarily asking easy questions.* The greatest problem school integration of technology has been the inability to ask the right questions about comprehensive technology integration. To understand the nature of the problem and to ask the right questions, schools must understand the various barriers that block effective curriculum-technology integration.

Barrier #1: Failure to distinguish the computer from the emerging technologies or learning technologies. While computers occupy a central powerful technology position, emerging technologies encompass much more than just computers. They include a wide range of technologies: computer technology—microcomputer, laptop, mainframe, local area networks, wide areas networks; telecommunications technology—online databases, facsimile transmission, distance learning, satellite, cable TV, external networking, microwave, wireless,

modems; optical disc technology—videodisc, CD-ROM; administrative technology—electronic card catalog, computerized circulation, voice mail, and learning technology—Electronic Teaming, Hypermedia, Multimedia, Electronic Simulation, and Integrated Learning Systems.

The term *emerging technologies* is preferred over the commonly used term computers or *technology*. The term emerging technologies denotes that there are several different types of technology and are evolving into something different, more powerful, more useful than the previous versions (Burrus, 1993).

Failure to embrace all of the emerging technologies has caused major problems for those school districts and sites who are working on technology integration. Many people do not see the computer as anything more than an electronic typewriter which only requires specialized skill training in word processing, spread sheets, and databases. As a consequence, technology is seen as an "add on" to the existing curriculum.

Compare the frequently heard question to the right question that technology leaders should be asking:

Frequently Heard Question: How do should **computers** be integrated into the **existing** curriculum?

Right Question: How should **emerging technologies** be integrated into an integrated, **authentic** curriculum?

Barrier #2: Failure to develop a vision of how technology should be used in all aspects of teaching and learning. Many educational leaders have failed to come to grips with the basic role of technology in teaching and in learning. Developing an understanding of the power and potential of technology in teaching and learning must precede all aspects of curriculum-technology integration (See Bailey & Lumley, 1994). Three interrelated, major questions need to be asked about using technology when developing a vision about technology as a teaching-learning tool:

1. *Should technology be used as an aid to teaching and learning*? By this question, we are asking or implying that technology can be used as enrichment or remediation to our existing curriculum? Viewed in this fashion, technology is a tool for enhancing the existing curriculum (i.e. only doing what we have been doing—only better or more efficiently with technology).
2. *Should technology be taught as a subject*? By this question, we are asking whether technology should be seen as a subject in itself (i.e technology as a part of the curriculum that exists along side the existing academic curriculum) as well as a tool used to learn the curriculum? The current Technology Preparation movements can be viewed as technology-as-subject which is offered with the regular academic curriculum.
3. *Should technology be used as empowerment tool in teaching and learning*? By asking this last question, we are implying that technology is a "tool that students use to learn" rather than a tool that "teachers use to place information in students' heads." Equally important, this question implies that technology can be used to transform the very nature of teaching and learning—*teacher-as-guide while student becomes primary consumer and creator of information.*

Failure to develop a clear vision for the use of technology in teaching and learning means avoiding the right question—what should technology be used for? The inability of educational leaders to ask the right question about the role of technology has led to wide spread retreat of using of technology-as-aid—a tool to enhance current practice.

Compare the frequently heard question to the right question that technology leaders should be asking:

Frequently Heard Question: How do we integrate **computers** into the existing curriculum?

Right Question: How do we develop a vision of maximizing the potential of technology before we focus on integrating technology into the curriculum?

Barrier #3: Failure to prepare and implement district and site technology plans as prerequisites to any curriculum-technology integration activities. A technology plan must be the foundation of curriculum technology integration efforts. The mission, policies, and priorities have to be in place before educators tinker with the "how and where" of curriculum integration (See Lumley & Bailey, 1993). If the school district and sites do not know where they are headed with technology, any kind of curriculum-technology integration effort will seem successful.

Failure to develop comprehensive technology plans leads to automation of past practices—at best. At worst, lack of technology planning leads to a perpetuation of past teaching and learning strategies without the use of technology.

Compare the frequently heard question to the right question that technology leaders should be asking:

Frequently Heard Question: How do we integrate technology into the current curriculum?

Right Question: What kind of technology plan do we need to have in place before we engage in serious curriculum-technology integration efforts?

Barrier #4: Failure to design and implement a technology staff development program as a prerequisite to curriculum-technology integration activities. Once a technology plan is established and monitored on a regular basis, the second major priority must be implementing a technology staff development program (See Bailey & Lumley, 1994). However, the technology staff development program must go beyond any existing staff development program(s) normally found in schools and school districts. A technology staff development program targets all players in the school district as participants—not just teachers. The technology staff development program provides the "big picture" to everyone who impacts student learning—teachers, administrators, board members, and support staff.

The technology staff development plan goes beyond computer skill training such as word processing, spreadsheets, and data bases. It focuses on all the emerging technologies and how they transform the teaching-learning process. In addition, the technology staff development plan must avoid the pitfalls of conventional staff development programs: (1) "one style fits all," (2) "one shot" efforts with no or limited follow-through, and (3) new information without demonstration, practice, feedback, and coaching (Joyce and Showers, 1988). Unfortunately, few comprehensive technology staff development programs are prerequisites to curriculum-technology integration efforts.

Compare the frequently heard question to the right question that technology leaders should be asking:

Frequently Heard Question: How do we integrate technology staff development to impact the current curriculum?

Right Question: What kind of technology staff development program should we develop and implement which will help us determine appropriate strategies for integrating technology into the curriculum?

Barrier #6: Seeing technology integration from "traditional" curriculum leadership perspective.

Traditional curriculum beliefs view computers or technology as new skills to be taught—"added on" to the existing curriculum. This curriculum leadership stance embraces the concept that student outcomes can be identified, isolated, and "plugged in" a scope and sequence chart. "Adding on" to the existing curriculum but not necessarily changing the curriculum becomes the leadership priority.

The emerging technologies allow schools to depart from traditional views of curriculum. If curriculum is a process rather than discrete outcomes, students will engage in authentic questions (i.e. meaningful, stimulating, relevant, worthwhile) which lead to new and exciting ways of learning. Emerging technologies allow educators to see students as entrepreneurs of learning—creating new information as opposed to simply digesting and storing information for later use in life. Emerging technologies allow teachers who become coaches and facilitators of entrepreneur-like learning. Failure to accept a radical transformation away from the traditional curriculum-evaluation paradigm means the end of schools as outlined by Lewis Perelman in *School's Out* (1992). Emerging technologies are wonderful tools for allowing students to move away from facts and memorization to higher order thinking, creativity, and creation (Ross & Bailey, 1995).

The emerging technologies allow us to view curriculum as new information "what could be" and "just-in-time" information when solving problems as opposed to collecting and storing information for obscure reasons. Conventional curriculum leadership focuses the known, not the new and the unknown.

Compare the frequently heard question to the right question that technology leaders should be asking:

Frequently Heard Question: How should we integrate technology into our current curriculum?

Right Question: How can the emerging technologies help us to create a new definition of curriculum?

Barrier #7: Failure to understand the basic differences between information literacy and basic literacy. Conventional curriculum beliefs stress basic skills. Basic literacy deals with core skills that all students need to function daily—reading, writing, and calculating math. Twenty-first century technology-based curriculum retains basic literacy but extends basic literacy to include information literacy. Information literacy is defined as identifying, accessing, applying, and creating information.

This new definition and understanding of literacy also underscores there is an abundance as well as an explosion of information. Advocates of information literacy recognize that information is doubling every two to three years. Finding, using and/or creating new information is and will be the norm; contrasting with memorizing and regurgitating information found in textbooks. The average student will encounter more information in their formal Pre-K–12 school experience than their grandparents were exposed to in a lifetime. It is no longer possible for a student to learn all they need to know in school. The exponential increase in information requires more than memorization—it requires the ability to sort and sift information to find solutions to complex questions. It requires students to be information literate. Information literacy will define successful, productive citizenship in the 21st century.

Compare the frequently heard question to the right question that technology leaders should be asking:

Frequently Heard Question: How should we integrate technology into our current curriculum?

Right Question: How can technology help us teach both basic literacy as well as information literacy in the school curriculum?

Barrier #8: Failure to understand that emerging technologies represent the most comprehensive, valuable set of curriculum materials ever available to humankind. Ironically, much of the vast curriculum reservoir remains untapped by teachers or students. More curriculum materials are available electronically outside school walls than will ever be found inside school walls. Textbooks are no longer the sole source or even major source of knowledge. Much of the entire Pre-K–12 curriculum is based on textbook materials which are out of date even as they are printed.

Compare the frequently heard question to the right question that technology leaders should be asking:

Frequently Heard Question: How should we integrate technology into our current curriculum?

Right Question: How do we use technology to redefine curriculum materials—both the information and the location of the information?

Barrier #9: Failure to empower students and teachers to engage in risk-taking and experimentation with the emerging technologies. Current curriculum and methods of transmitting curriculum are steeped in traditional ideas of minimizing student failure. Student success is translated into correct answers about known questions in the school curriculum. Based on the phenomenal amount of change that is occurring, few school curriculums are getting students ready for the challenges of the 21st century. Students need to be challenged to ask questions to which there are "no answers," and engage in experiments where failure is more the norm than success. Trial-and-error, risk-taking, failure, asking questions, perseverance are increasingly becoming prerequisites to success and knowledge (Ross & Bailey, 1995).

Compare the frequently heard question to the right question that technology leaders should be asking:

Frequently Heard Question: How should we integrate technology into our current curriculum (to ensure student success)?

Right Question: How do we use technology to create information—take risks and experiment to find new answers to existing and future problems.

Barrier #10: Failure to see the curriculum as something more than the written word or text. For many, a technology-infused curriculum means making computers accessible to text-based (written material). The computer is seen as a "word cruncher" or electronic typewriter. Curriculum means much more than the written word. In addition to text, the new curriculum involves sound, video, graphics. Seen in this light, literacy is much more than print information or concept understandings—it becomes visual literacy. In Marshall McLuhan-like words, "Gutenberg made us readers but the emerging technologies have made us authors, producers, directors, actors, and artists." We must facilitate visual literacy as well as text literacy in student learning.

Compare the frequently heard question to the right question that technology leaders should be asking:

Frequently Heard Question: How should we integrate technology into our current curriculum?

Right Question: How can we redefine our curriculum by including all sources of information including audio, video, graphics—not just print materials.

Barrier #11: Failure to integrate technology into basic learning process—both outside and inside the classroom. For many educators, the computer lab has been the answer to integrating technology into the curriculum. The physical placement of computer labs in schools has been the solution to the problem of technology (computer) access as well as how to impart computer knowledge. The answer of computer lab or technology lab is an answer to a well-meaning but wrong question: Where do we place computers?

Technology is more than word processing, spreadsheet, database skills. Technology is both the tools for learning the curriculum **plus** the source of curriculum materials themselves. Could you imagine trying to teach a child any subject without providing paper or pencils? Could you imagine telling a child,

now it is time to go to Pencil and Paper Lab 101 because we can not provide them to you here—where you are? Technology must be integrated into every aspect of learning—not a location where technology is studied and used. As early as 1984 Seymour Papert was articulating a vision of schools where technology was as much a part of curriculum as pencils are in traditional schools.

Compare the frequently heard question to the right question that technology leaders should be asking:

Frequently Heard Question: Where do we put computers (which will facilitate curriculum-technology integration)?

Right Question: How do we get all of the emerging technologies into the hands of students which allows them to learn anything, anytime, anywhere—as a total process of curriculum-technology integration?

Four Suggested Steps to Initiate Curriculum-Technology Integration Strategies

The importance of integrating technology into the school curriculum can not be overstated. However, several preliminary steps must be taken to ensure that the curriculum-technology integration strategies will have the intended and appropriate impact on student learning. Consider the following sequence of curriculum-technology integration steps:

Step 1. Empower people to become technology leaders in your school district. Administrators as well as teachers must surface as technology leaders. In every school district and building, there must be a champion or champions of technology who work in teams on the problems and issues of technology integration (Bailey, Ross, & Bailey, 1995).

Step 2: Develop comprehensive technology plans and allow the empowered technology leaders to facilitate the plan both at the district and building level.

Step 3: Create technology staff development programs which support the technology plan—both at the district and building level.

Step 4: Devise action plans which address specific activities to integrate technology into the curriculum which are based on the technology plans as well as technology staff development plans.

Summary

Imagine a young girl, in the not too distant future, who has a device inside a pair of sunglasses that can tap into a global library of books, mail, speeches, movies, and limitless video and data sources. Critical thinking, complex problem solving, and knowledge creation characterize her curriculum whereas her mother's and father's curriculum carried the hallmark of memorization and regurgitation. She is a goldfish released from its fishbowl into a ocean of unlimited learning. Anything she can conceive, she can achieve because she has mastered information literacy. All the world's curriculum treasures are hers for the taking. This is not a dream but reality within our grasp.

What is our challenge? We can create and shape our children's and grandchildren's educational future or we can let the future create and shape their education. We have a choice about our future. The first step begins by having the ability to ask the right questions.

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Learning organizations find ways to insure training and staff development efforts to satisfy both individual needs and organizational goals. This article shows that schools seeking to integrate technology into the mainstream program can develop methods to accomplish just-in-time technology learning.

Just in Time Learning in a Learning Organization

John K. Burke

It was 3:30 p.m. on a Wednesday afternoon. He entered the second grade classroom and asked the teacher, "Have you been surfing the 'net' ?" She replied that she wasn't sure how to do it. "If you have a few minutes I can show you," he continued.

He asked her to take control of the mouse. "Double click on your hard drive", he told her. She did. "Look for a folder called 'Internet Programs' and double click on it", he added. She found the folder and double clicked on it. "Now double click on Netscape", he offered. "Find net search and single click on it. Find Webcrawler and single click on it. Click on the dialogue box and type in 'Edlinks'." The Edlinks homepage arrived on her computer screen. "Now scroll through and notice all the interesting links that are available." "When you get to 'Askeric', single click and then single click on lesson plans." "What subject areas and grade levels would you like to find for your immediate use?" "Let's look at a few." "Let's make a bookmark so that we can return here easily next time," he offered. "Just click on the Bookmark pull-down menu and drag to make a bookmark and we can skip many of these steps and go right to it next time."

The teacher quickly reviewed several useful lesson plans. "Wow, I've got to show this to the teacher across the hall. When are we going to receive inservice on this?", she asked. He replied, "You just did." Now that you know how to do it, you can teach your colleague across the hall," he continued.

This entire exchange lasted a total of ten minutes. He, it turns out, is the superintendent of schools. Staff development is for everyone in a learning organization. This "each one teach one" strategy may seem labor-intensive on the surface, but by the end of the week, all of the teachers in the building had been through a one-on-one lesson and were actively surfing the Net.

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A Learning Organization

In 1990, Peter Senge wrote *The Fifth Discipline: The Art and Practice of the Learning Organization* and introduced the world to the concept of the learning organization. Senge wrote of learning organizations, ". . . (They) are the organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together."

In a learning organization such as this, the usual staff development techniques are not very helpful. Requiring twenty teachers to meet with the technology facilitator in the computer lab hasn't been very successful. Adult learning theory tells us that adults learn best when they perceive they have a need to learn. Twenty teachers required to attend an inservice in which the most knowledgeable third of the teachers will be bored, the least knowledgeable third of the teachers will be confused, and the middle third of the teachers might find the information helpful but not timely has been efficient, but not very effective.

In 1993, Dennis Sparks offered his analysis of powerful staff development. In his view, in order to be most powerful, staff development should be results-driven, systemic and constructivist. It should be results-driven in that the learner will know . . . after the staff development process is completed. It should be systemic in relation to the teacher's function within the learning organization. It should be constructivist in that the learner is able to take previous experience, coupled with new information and create meaningful changes in behavior, thought or perception.

A learning organization will need to look at staff development in these new and different ways. Each-one, teach-one is one highly effective staff development strategy that can help the most reluctant learner grasp the importance of additional learning. The effectiveness of this technique is due largely to its highly personal nature. When teaching and learning can occur "eye ball to eye ball" and "knee to knee", the teacher and learner can customize lessons. Other techniques which have proven to be very powerful involve teachers with expertise in technology providing mini-lessons for interested teachers, dream school visioning, and building custodians who have been trained to serve as technology trouble shooters.

In *The Adult Learner: A Neglected Species* (1990), Malcolm Knowles stated five issues must be considered when working with learners of any age. These issues are: "(1) letting learners know why something is important to learn, (2) showing learners how to direct themselves through information, and (3) relating the topic to the learners' experiences. In addition (4) "people will not learn until ready and motivated to learn. Often this (5) requires helping them overcome inhibitions, behaviors, and beliefs about learning."

An Encyclopedia of Experts

A learning organization assumes that everyone is interested in learning. Teaching and learning occur constantly and hierarchical levels are blurred as everyone learns together. The development of an encyclopedia of experts is one way for teachers and other members of the learning organization to locate sources for specific learning. Members who feel that they are proficient in a particular software program or application contact the technology facilitator who compiles a catalogue of personnel with indicated areas of expertise. This encyclopedia of experts is distributed to all members of the learning organization. When someone needs to learn a particular software application, they consult the catalogue and contact the expert. They arrange to meet and the staff development is conducted just in time with just the right software and a very personal approach.

Dream School Visioning

Dream school visioning is a technique learning organizations can use to move the existing organization to explore new patterns and operations. Stakeholders (teachers, administrators, board members, parents, patrons, and students) examine the culture of the school as they know it and determine what is working and what might be changed. Typical areas which receive consideration are curriculum, instruction and structure.

Reading required best-practices literature prior to this experience is essential to the improvement process. If the stakeholders enter into this exercise without the literature search intervention, the dream school will likely look much like the existing schools. For example, Ted Sizer's *Horace's School* provides readers with a story about high school teachers wrestling with changing school as they know it. Their examination of best practices in the areas of curriculum, instruction and school structure offered stakeholders insight into the different methods of operation as well as an understanding of the change process within schools. The expression, "If you always do what you've always done, you'll always get what you always got," fits nicely here. The best-practices literature intervention primes the dream school visioning pump.

As dreams emerge from the stakeholders they can usually be grouped into one of three categories: curriculum, instruction, and structure. The stakeholders serve as a committee of the whole to consider how the three categories interrelate. Next the stakeholders are asked to self select one of three areas (curriculum, instruction, and structure) to serve on a team for one area. The members of each team develop action plans of how to move the organization from the culture of the school as it exists to the culture of the school as it is envisioned. The plans take into account obstacles and include plans to overcome the obstacles. Periodically the three teams meet to consider how the action plans impact the system as a whole. Action plans are initiated with a prearranged system of review for assessment and/or correction.

Dream school visioning offers staff development that is constructivist as the stakeholders consider how to take previous knowledge and new knowledge and fashion a future school that did not exist. It is systemic too in its consideration of the interrelationships among curriculum, instruction and structure. Finally, it is results driven. The entire process is designed to develop an action plan which can be implemented.

Custodian as Technology System Operator

One rarely considered school technology resource is the building level custodian. Many schools have invested huge sums of money for computer key operators and trouble shooters under the assumption that the only personnel with the expertise to trouble shoot computers and networks is a highly compensated administrator. Some schools have trained teachers for these functions only to discover that most of the time the teacher is committed to classroom teaching. Teacher schedules rarely allow the kind of flexibility necessary to handle untimely network malfunctions.

Conversely, most building level custodians possess mechanical aptitude, have a flexible schedule, and respond well to the additional challenge of learning how to trouble shoot computers and networks. Some have been given the most powerful computers in the district, equipped with CD ROM and Internet access, coupled with Apple Maintenance Software for situations which require research. In a learning organization everyone learns all of the time.

Staff development in a learning organization considers the learning of all stakeholders. It uses what is known about powerful learning theory and the best practices of being results-driven, systemic, and constructivist. It is geared to the individual and is timed so as to be coupled with a motivation to learn. Everyone is considered and continuous improvement is expected. Each one teach one, an encyclopedia of experts, dream school visioning, and custodians as technology system operators are just a few of the staff development functions available in a learning organization.

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The importance of support services for the effective implementation of technology in the classroom cannot be overlooked. The lack of technical support has caused expensive equipment to remain unused by classroom teachers. This article focuses on the need for on-going technical support.

TECHNICAL SUPPORT: A Key Component for Successful Technology Integration

Max K. Frazier

Have you ever faced an important deadline, only to have a critical piece of equipment like a VCR, copier, computer, or piece of software fail to work properly? What did you do? Who did you call? How did you solve the problem so you could complete your work on time?

As the modern school has come to rely on emerging technologies to manage information and enhance student learning, the challenge of supporting the users of these technologies has become more complex and difficult. The task of integrating the wide variety of new technologies into a classroom or school is like a large puzzle; all of the pieces are vital in creating the finished product. Without the planning, training, and support in place, the integration of these new technologies can be very difficult. Adequate and timely technical support is of critical importance to the users of educational technology, but this support is often overlooked as a part of the larger puzzle of successful technology integration.

The number of computers and other emerging technologies has expanded greatly in American public schools in the last decade. These technologies have broadened and enriched the learning experiences for students, but the increased use of these technologies have created a new set of problems for schools to confront. As schools have adopted and begun to use such emerging technologies as networks, telecommunications, CD-ROM and laser disc technologies, scanners, and the Internet; teachers and administrators are faced with the question of what to do when the equipment does not work properly, needs to be maintained, or when help is needed in managing or operating these new tools for teaching and learning.

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The Technological Infrastructure

Computers and related technology have become part of the infrastructure of the modern school. Just as the electrical and plumbing systems of the building provide necessary basic services such as lights and running water, computers too provide some of the same sorts of basic services in schools today. Attendance, record keeping for transcripts, correspondence, grade cards, lunch tickets, as well as tools for writing, creating presentations, or doing research depend on computer systems and technology.

If a pipe in the school breaks and the water system does not work correctly, we call a plumber. If the lights do not work properly, an electrician is called. Often, members of the district staff are trained and licensed professionals whose job is to maintain these plumbing and electrical systems for the schools. But what of computer systems? If software needs to be installed, maintenance done to the computer network, or questions need to be answered, is there someone who is easily and quickly accessible to do these sorts of jobs?

Technical assistance is of vital importance to computer users. Computer hardware and software companies have entire staffs devoted to answering questions and offering assistance to their customers. But often, schools overlook the importance of these services for a district or school. They may assume that the "technology teacher" can adequately handle the problems which come up. Failure to provide technical support can lead to frustration, anger, and non-use of the technology by district staff. This lack of technical support is one of the mistakes frequently made by leaders wishing to integrate technology in schools.

Levels of Technical Support

Technical Support must be available on a variety of different levels. Part of this support must be in the area of installation. Technology can be very intimidating to people. Help may be needed in setting up new equipment, adding new items to existing systems, or installing new or updated software. After the equipment or software is installed, help may be needed in configuring it so that it will work properly. Teachers and other busy professional educators do not have the time to figure out how to configure the sound board for their new CD-ROM or make sure that the new machines have been properly attached to the network. Having a technical support person available to do jobs like these is essential in making the most of new technology purchases.

Maintaining the technology within a building is another area in which support is needed. Computers must periodically be cleaned, adjustments made to equipment, or software reconfigured. When a piece of equipment fails to work, help is needed in diagnosing and, if possible, repairing the problem. This may be as simple as reinstalling system software, replacing a printer cable, or it may require a trip to a repair facility. Identifying who will drop off the malfunctioning equipment, make arrangements for a service call, and picking up repairs will minimize the time a system or item is not available for use.

Assistance is often required in solving the problems which arise in using or learning about new educational technologies. New equipment or software may not work properly when first installed or set-up. Most manufacturers do have a phone number to call to get the answers to technical questions. However, these phone calls often require long waits and some knowledge of technical matters is helpful when making these calls. Technical support personnel have the time to make these

phone calls, wait for answers, make follow up calls, and get problems solved in a timely manner. The failure to have such personnel available to solve problems with equipment may lead to resistance among staff to adopt new and better software tools or make the most of new systems.

Support must also be available in the form of answers to the various questions which arise in the use of technology. This support comes in the form of quick answers to questions about a piece of equipment or software. Sometimes the answer to such a question can be the difference between time wasted in frustration and getting the job done. These answers need to be available on a timely basis in order to keep technology users from wasting too much time on getting the answer to a question which keeps them from getting to the task at hand.

Technical Support Roles

Who is to provide this support for a school? A designated technology coordinator with a clearly defined job description is important in providing quality technical support. This person is responsible for establishing plans for the integration of technology in the building or district and should be charged with defining and developing a system of support for the school. In addition to a technology coordinator, a technician responsible for the maintenance and repair of equipment is very important as well. Small districts may not be able to afford to have such a person on staff, but having a designated outside technician, shop, or vendor who make service calls is an acceptable alternative. Knowing who to call when things go wrong can minimize frustration and time lost while equipment is not working.

A school can also benefit from using students to help support technology within the building. Students are often less intimidated by technology than teachers or other staff. Choosing students who show promising skills with technology and then developing these skills with additional training can produce very competent support personnel for many typical problems and tasks. These students can answer questions, do simple training with software and hardware, investigate and report on problems, install software and simple hardware, and do basic maintenance. These responsibilities can enhance student confidence and develop real on-the-job-skills for these students while providing timely support to building staff. Schools often overlook the support which can be provided by well trained students as they look for solutions to the technical support puzzle.

Concepts of Support

Two concepts which can be important to consider in developing appropriate technical support are "plug 'n play" and "hot line help". "Plug 'n play" means that teachers and students will be able to use the new technology with a minimum of anxiety and frustration. Choosing new software and equipment with the end user in mind, and doing serious evaluation of both equipment and software can help to make the choice of new products appropriate for the users. Change is often difficult for people, and adapting to new equipment or program versions can be a source of great anxiety and frustration. Choosing new items which lend themselves easily to use will help the transition to a new product seem easier.

"Hot line help" is the idea of making answers to questions or help with problems a quick and easy process. Calls to software and hardware companies can often take large amounts of time while wading through an automated voice-mail system or simply waiting for the next available person to answer your question. The frustration of waiting for 45 minutes to ask a question is often more time than the average teacher has. Technical support at the district or building level is usually much quicker and less frustrating. By making equipment and software support only a phone call and a few minutes away will make users more willing to make use of new technologies in the classroom.

In addition to having local support available, it is often helpful to train staff to do basic trouble shooting and problem solving when they encounter difficulty. Nothing is more embarrassing for a user than reporting a problem with the operation of a piece of equipment, only to have support arrive and find that the unit had not been plugged into the wall. Teaching staff to do basic trouble shooting like checking the connection to power and cabling is an important skill in helping people to understand the equipment they work with and feeling comfortable with it.

The challenge of successfully integrating the emerging technologies into the educational process is a difficult one for schools. By providing adequate technical support in a timely fashion, this task will be much easier for the teachers and staff faced with learning about and implementing the use of these technologies. Having a knowledgeable technology coordinator will help to make installation and maintenance of this technology much simpler for the users. An on-site or designated repair facility will quickly facilitate the repair of equipment problems and breakdowns. Understanding and using the concepts of "plug 'n play" and "hot line help" when choosing new software and hardware, and in providing support to users will make users more confident in using unfamiliar technologies. Making use of students to provide technical assistance will help to develop real world skills and provide timely assistance to building users. By providing quality support to users, it is possible to make the integration of technology into schools and classrooms less frustrating and painful. This support makes it possible to use these technologies to their fullest, to enhance the educational process and empower the learner to accomplish much more than was possible without the use of the emerging technologies.

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Technology support is one of the crucial factors for the successful integration of electronic technologies in the classroom. Failure to plan and provide on-going technology support has doomed many ambitious educational technology efforts.

TECHNICAL SUPPORT: What is it and how do we provide it?

Bill Bridges

There's no picture on my monitor. My computer won't start. How do I make columns? The network's down. What computer should I buy? What's it cost? Where's my printer? Have you ever asked these questions or made these statements? If so, you were seeking technology support.

What is technology support? Technology support are the assets needed to resolve questions, accomplish planning, and provide availability of technology systems to end users. Technology support is not limited to repairs or help desk functions. All aspects of technology require support. The importance of this support is related to the importance placed on technology by the Board of Education, the administration, teachers, and staff. The key to insuring effective technology support is a technology leader within the district administration. The technology leader insures the technology awareness of the Superintendent and the Board so that technology support remains a high priority.

With a technology leader in place and a high priority placed on making effective technology support available, we must determine what technology support will be provided and by who. Technology hardware and software systems generally belong to one of three functions: education, education administration, and administration. The functions can be defined as:

Education—Systems used by the students and teachers for instruction and learning (i.e. student labs, library systems, classroom presentation systems.)

Education Administration—Systems used by teachers or administration to manage student data (i.e., grades, transcripts, student records, health records.)

Administration—Systems used by administration to conduct day-to-day business (i.e. payroll, financial, personnel records.)

If District technical support is only concerned with one of the three categories, priorities and focus are much easier to manage. However, covering all three priorities is much more complex. For our purposes, assume a worst case scenario—our technology leader will provide support in all three categories.

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Before defining an organization to provide technical support, we need to look at the various areas of support. From the District view point there are fourteen major categories. Each area has unique support responsibilities:

Repairs—The most straight forward area to address. This is usually the "broke, fix it" request. It fits into three classifications, hardware, software, and "I don't know." Hardware and software repair are easier problems. In most instances, the time it takes to make repairs is a question of where the system falls on the priority list and what support level the District is willing to provide. The "I don't know" problem is always harder to define. It may be a combination of software and hardware problems and not easily definable.

Help Desk Support—True help desk support is support provided over the telephone. Software support consists of "how to" and "what key to press" information. Hardware support relies heavily on good user observation of symptoms and system error messages. A good help desk needs knowledgeable help desk personnel, observant users, and District standards for hardware and software. Its impossible to know every software package or every hardware configuration.

Curriculum/Technology Integration—A fuzzy area for technical support. Questions in this area generally start with "I need to . . ." and fits one of three needs: awareness of capabilities, skills training, or appropriate/non-appropriate uses of technology in a curriculum. Supporting this area takes personnel with excellent educational credentials and extensive training in technology systems.

Technology Purchasing—A complex, essential area. Composed of many steps—procurement, receipt, asset tracking, setup, and installation. While many of these steps are assigned to other departments such as purchasing or accounts payable, technical support must maintain an overview. They must insure that technology purchases are compatible with District standards and obtained at education discounts. If technical support is not aware of the status of technology purchases, delays will be encountered in implementing those systems for the users.

Network Administration—Consists of performing minor maintenance functions for the network such as adding new users, removing old users, managing printers, and assigning work groups. Some network administration can become very technical. If it is beneficial for on-site administrators to undertake all administration functions, plan on several weeks of training and testing to qualify them as a Certified Network Administrator (CNA).

Network Supervision—The task of installing networks, managing operating system files and setting up hard disk storage volumes. In addition to CNA training, additional courses and tests must be passed to become a Certified Network Engineer (CNE). Support of these functions is best left to full time technicians. On-site personnel cannot usually find the time for either the training or the performance of these functions.

Network Design—Interpreting needs into network topologies, cabling, hardware, and network operating systems. Very complex issues usually the responsibility of CNEs. Network configurations are never stable. Personnel move and work stations added. Every time this happens, someone reviews the design of the existing network and determines how to expand. Network hardware and software have technical limits. To achieve acceptable levels of performance, additions to existing network systems require design work by technically qualified personnel.

Programming—Normally programming requests are made by Administration. They range from major changes in personnel, financial, or student administrative software systems to small databases to make work easier. If the District is fortunate and can use commercial software "out-of-the-box" for administrative purposes, this technical support function can be minimized.

Telecommunications—The current trend towards wide area networks (WANs) and on-line information makes treating telephone systems as technology systems more important. The introduction of voice mail makes every telephone line a potential data carrier and extension of a network. The emerging capability to transmit voice, video, and data over a single wire for video conferencing and Internet access requires that technical support be available for these systems.

Audio/Visual—The increasing use of centralized video distribution systems, networked media facilities, cable television, and TV or projector display of computer monitors has dragged audio/visual capabilities into the technology mix. Traditional A/V systems such as VCRs, projectors, and televisions are so integrated with computer technologies that they can no longer be treated as a separate area. The use of live video and video editing by students has made these systems critical to the education process and a necessary subject of technical support.

Network Cable—No longer can an electrician install cabling for computers. High performance copper wire, fiber optics and network medium interfaces have spawned an entire new field of technology. Network cabling operates with different standards and specifications than electrical systems. Many of the problems encountered in networks are the result of improper cable installation or breakdown after installation. Resolution of these problems requires highly skilled technical support personnel.

Computer Operations—A term usually applied to school districts which rely on mainframe or mid-range computer systems for "mission critical" applications. These systems require support to operate properly, run District or school reports, and insure the security of District data. With the coming of powerful PC systems, many functions can and have been downsized and made the responsibility of the users. However, the function of computer operations remains and is still a part of technology support for the District.

Information—Not the same as help desk support. Requests for information are questions such as "What computer or software should I buy" and "I need a network design." If these requests are not answered by technical support, everyone does their own "shopping" and occasionally gets it wrong. At best, there is a lot of time spent researching when it could be done faster with good technical support. Included in this area is the need for technical support administration; technology planning; advisory information to committees, groups, and buildings; and District technology oversight.

Technology Training—It can be argued that in school districts, this area belongs to staff development and is not a technical support issue. Technical support must work closely with staff development in this area, but training will be enhanced and more effective when made the responsibility of technical support. Changing technologies will be recognized sooner by the technical support group enabling them to modify training appropriately at an earlier stage in staff development. While technology training is most often though of as skills training (i.e., word processing, spreadsheets), there are curriculum and teaching considerations which are also part of the concept. The two must be integrated in staff development to provide the greatest benefit to students.

There are additional topics to consider: priority, level, and type of support. Priority refers to who gets service first, level answers how fast support arrives, and type determines who provides the support. District decisions in these areas determine the size, composition, scope, and cost of the technical support organization.

Priorities generally relate to the functions of education, education administration, and administration. For an educational institution, the categories above are listed in the appropriate priority order. However, within the three functions there are various types of technology systems which affect students to a greater or lesser degree. A better list of priorities might look like this:

Exceptions
School-wide Educational Networks
Classroom Educational Networks
Standalone Classroom Technology
Building-wide Administrative Networks
Standalone Administrative Technology
Everything Else

Comments are needed to insure an understanding of these technical support priorities. There will always be exceptions. When there is a problem producing paychecks accurately and on time—**BELIEVE** that there will be an exception. The important thing about an exception is that there is a prescribed method for determining which items become exceptions and who makes that determination. Determinations should be made on a case basis to avoid "blanket" exceptions for a particular group or function. The use of the term networks refers equally to video retrieval systems, computer networks or distance learning networks. When establishing the priority system, provide written guidelines defining the terms.

The help desk is the only category of support not providing support based on priorities. By its nature, help desk support is first-come-first-served. However, one function of the help desk is to call the attention of other support categories to high priority problems. Therefore, they must be aware of priorities, able to identify high priority problems, and take timely steps to resolve them.

Levels of support are usually defined in terms of hours or days. It is important to define two milestones when specifying a level of technical support: the initial contact after a problem is reported and the time frame for completion. Several levels may be defined within a category based on variations required to effect resolution. An example: If an educational network requires hardware repair, the initial contact milestone may be one hour with a completion milestone of one day if parts are available and three days if parts must be ordered. Accounting for these variations requires a set of matrices by category, variations and milestones. If this sounds like a lot of work, it is. But, the decisions made during this process have the single greatest influence on technical support costs.

Another factor to consider in determining levels of support is the goals for each level. It is one thing to say that the initial contact for a school building network is one hour. It is another to say that the goal is to make 100 percent of the initial contacts for this level of support in one hour. Should you maintain a network supervisor for each network in the District just so this level of support can be met? A power outage throughout the city can cause this to happen. Reasonable goals for each level of service must be set based on cost. It will test your District's commitment to technical support to set high technical support goals.

Finally, you must decide what type of technical support will be provided to the district. General support types are:

On-site—Personnel assigned at each site with designated responsibilities for technical support.

In-house—A designated group of specialists with responsibilities throughout the District. Scope can range from one to all technical support areas.

Contract—A prepaid contract with a commercial technical support service specifying the equipment to be supported and the time frame of response.

Case-By-Case—Purchasing support at the time of a needed service.

No District survives on only one type of technical support. Each type has benefits, drawbacks, and associated costs.

With all these considerations, it is easy to see why districts let technical support grow randomly producing an organization which either does not provide the expected support or provides it at unacceptable costs. Where do we begin to design a

technical support organization? The best beginning is to inventory district technology assets. (Don't forget to include software and networks.) Next, assign assets to one of the three functions; education, education administration, or administration. Having done this, we can determine which areas of technical support are required and the scope of each. At this stage of reviewing technical support requirements, look at the future. Where is the district going and what support will be needed. For most Districts, failure to look at the future will cause the technical support organization to be incapable of supporting current needs much less the future needs.

So far we have identified the scope of support required. Now comes the actual decisions. What are the priorities, what level of technical support do we want for each and how are we going to provide it. Remember, everyone wants to be supported first, instantly, and at the lowest cost. Answers to these questions must be determined by each District individually. There are no easy answers. A review of local commercial support sources will provide help in determining costs and perhaps even the level of support available. In the end, an organization should emerge which represents a balanced approach to technical support. Many districts try to separate educational and administrative technology support. In an integrated technology environment, technology systems form a continuum. Technology support provided from a single District group optimizes assets supports standardization.

The "final" organization has been determined. Now what do we do? Plan for review and change. The process of planning and review for technical support must be institutionalized. Every time we make significant changes to technology in the District, technical support must change. Without continuous review and restructuring of the technical support organization, it falls behind the need and affects the support technology provides for the District.

Change occurs whether it is led or not. Technology is a driving force behind educational change. The question is whether school leaders will lead in planned change for technology or allow the change to occur without their leadership.

CHANGE AND TECHNOLOGY LEADERSHIP: Two Sides of the Same Coin

Anita M. Pankake

Introduction

Our editors were most kind (or perhaps wise) in providing three guiding questions for this discussion on change and technology leadership:

1. What do technology leaders need to know about change and the change process?
2. What does the change process have to do with technology leadership?
   and,
3. What are the implications of the speed of change for technology integration?

Discouraged by the volume of issues to address within limited space available, consideration was given to addressing the three questions in the following way:

1. A lot!
2. Everything!
   and,
3. Many!

However, fearing the loss of two valued colleagues prevented me using this as a solution. And so, what follows is my attempt to give information specifically related to the questions posed. Setting up a situation in which readers become aware of the "need to know" is my overall objective. The information presented here barely scratches the surface of what is available regarding issues of change and technology leadership. Hopefully, however, readers will be persuaded in these pages that these issues are important and connected and they will want to know more.

In the meantime, some information related to each of the three areas is presented. The question regarding what technology leaders need to know about change and the change process seemed to be an important prerequisite to the discussion of anything else. As this area developed, points about the relationship of change and technology leadership surfaced. Implications of the speed of change for technology integration provided a nice framework for summarizing and attaching meaning to the material presented.

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What Technology Leaders Need to Know About Change and the Change Process—Information and Implications.

With each day what we know and what we don't know about change and the change process increases. In the last five years, the interest in change, how it happens and what keeps it from happening has been tremendous. Articles, workshops and research on change efforts are everywhere.

The success history of planned changes in education is pretty discouraging. When the number of successfully implemented changes is compared to the number of changes proposed, the resulting ratio can be truly disheartening. The track-record for the successful implementation of technological changes in education would appear to be similar to the history of planned changes in education generally. Evidence of this history is summarized in the following statements by Snider (1992). His words send a powerful message to technology leaders about why they need to know about change and the change process if the future is to differ from the past.

> "From lantern slides to language labs, from closed-circuit television to microcomputers, attempts to improve American schools with modern machines have been something less than a resounding success. Beginning with the magic lantern and the stereoscope of 1900, machines in the classroom have generated some promise, a fair amount of controversy, and a great deal of hype. During these 90-plus years, however, the basic acts of classroom teaching have changed very little despite sporadic efforts at research and reform—with and without machines." (p. 316)

As seems evident in Snider's statement, just having the technology does not assure the desired changes will occur. There is more to change than new equipment, good ideas and enthusiasm.

Whether the topic is technology, policy, programs, beliefs or most anything else, the processes of change are similar. Fullan (1991) notes that "any discussion with those involved in educational innovation and reform . . . quickly reveals that the nature of problems and many of the principles of success and failure have a great deal in common" (p. xiii). Additionally, he expresses optimism by pointing out that with our increasing knowledge about change and particularly in our examination of successful examples of change, the key feature seems to be "organized common sense".

Knowing the specifics of all of the situations in which technology leaders find or will find themselves in their attempts to bring changes to education is impossible. However, Fullan's assertions about the common features of changes wherever they occur are encouraging. And so, some important concepts from the literature on change are offered. These basics concepts should alert technology leaders of their "need to know" about change and the change process.

Change is a process not an event.

An understanding of this concept is essential to the success of any change effort. Treating change as an event is a sure way to reduce the possibilities of success. Change is a continual flow of activities; things change while we are trying to change things. There is no specific date, time, place or piece of equipment that can be marked as "the change event". This concept has been expressed in a variety of ways by a number of writers in the field (for example, see: Fullan, 1991 and Hord,

Rutherford, Huling–Austin & Hall, 1987). Unless technology leaders keep this in mind, they will model behaviors that focus on isolated events rather than continuous, inclusive processes that involve new behaviors and new beliefs, as well as, new materials and equipment.

Change as a process is nonlinear, multifaceted and a mess in the middle.

Not only do technology leaders need to understand that change is a process and not an event, they must further recognize that this process is not always predictable. While some planning and predicting are possible and needed it is also important to recognize that some ambiguity is normal; some things cannot be predicted—no matter how much planning is done. This need to understand the systemic, as well as, attempt the systematic in working with change is critical. Conner (1993) has some good advice for technology leaders as they initiate and move to implement changes: "Change is not a discrete event that occurs by linear progression; rather it unfolds on many different levels simultaneously. Instead of relying on hard and fast rules that can get you into trouble, acknowledge the complexity of change by focusing on the patterns and principles for your direction" (p. 10).

Change is not always viewed as progress and not everyone will be as excited about a particular change as the initiator.

Realizing this may be one of the most important change concepts for technology leaders to learn and use. It may also be one of the most difficult to accept. Ordinarily individuals propose changes that are intended to make things "better". Planned changes are based on what someone thinks is good or valued. The complication, of course, is that not everyone thinks the same way. What may be important and useful to one person may be viewed as a waste of time and money to another. The technology leader must understand that while change is inevitable, whether or not that change is progress is a very individualized value judgment. Assuming that everyone views all technological achievements as progress is silly and may even prove disastrous to change efforts. Not all change is progress. Remembering this will be important for technology leaders. This will help them keep a balance between their own enthusiasm and the doubts of others. This initial balance may help tip the scales in their favor in the long run.

Users must see a need for change or it will not occur.

This concept relates directly to the previous one. Not only must changes be viewed as progress, they must also be seen as needed. When people are happy (or at least satisfied) with the way things are, they will not invest the time energy and effort to change. In fact, why should they? From their perspective, "things are fine". Their recommendation may have a familiar ring, i.e., "If it ain't broke, don't fix it!" While the initiator may view a change as needed—others may not; and, until they do, not much will happen. Harvey (1990) recommends that change initiators make sure that what they are proposing is really needed. He advises making serious effort to honestly answer two questions: "Is there really a need for this program or proposal? Can you demonstrate that need clearly?" (p. 54) Further, he suggests that written statements be developed to address the question: "What facts show the need for this change?" (p. 55) Harvey's advice will help technology leaders demonstrate the need for a change and therefore make it more likely to be pursued.

The change must make life easier, not harder for the changees.

Change agents have often been frustrated with others because of their resistance to proposed changes. If not careful, there will be rush to label these individuals as "hold-outs" or "blockers" of progress. However, what they may be resisting is not the basic intent of the change, but the consequences of pursuing it. According to Conner (1993), "Change management is perception management. . . To gain commitment to move from the present state to the desired state, managers must be willing to honor (with action) employee perceptions of reality" (p. 103). The realities of those who must implement the change may be quite different than the reality of the change initiator. Technology leaders must remember that it is easier to see the merits of a change if you can also see the pay-off for doing it. Harvey (1990) suggests, "It is natural and indeed, sane to resist doing something until there is a clear payoff for doing it." This payoff needs to be evident for those who have to do the changing, not just for those who are proposing that things be changed. When technology leaders acknowledge the viewpoints of others it goes a long way in helping people see them as understanding and not just demanding.

Change costs.

The costs of change are varied, but there are always costs. Fullan (1991) identifies it as, Change is resources hungry! The costs for change often are in real dollars, but not always. Change can also cost in terms of time or energy, or the loss of a valued colleague or a move from a home, etc. Change involves giving up some things to get some other things—hopefully new and improved. Change not only costs initially, but it continues to cost. In fact, the costs may increase in order to maintain or continue to improve. Technology leaders know how this upward spiral works. For example, often new technologies brought into an organization (classroom, school, etc.) create new demands for even more technologies; or, when new technologies are adopted to increase efficiency and "save time" the result is often increased responsibilities and demands that take the "saved" time and more to accomplish. However, the most important cost to recognize is what it costs an individual to move from the known to the unknown. According to Conner (1993), "Managing effective transitions does not allow for dealing with a single reality; it involves managing multiple realities as seen through various people's fears, hopes, and aspirations—their frames of reference (p. 103). Because change happens one person at a time the cost of losing the known is a very individual matter. Therefore, technology leaders need to work with individuals to help each person see the cost-benefits for them in changing. The cost of losing the known is the price that must be paid for changing.

Change does not occur in isolation.

Each of the previous points leads to this one. In Rifkin's Entropy (1980) he writes, "Everything in this world is connected with everything else in a delicate and complex web of interrelationships" (p. 226). Thinking small and isolated may be the worst behavior the technology leader can demonstrate. On the other hand, an argument could be made that thinking too globally and not paying attention to details may be the worst. But perhaps it is not doing both that is the real problem. Seeing the big picture and the small picture simultaneously is necessary if changes are to succeed. Seeing things and not people, seeing people as separate from each other or their work, not realizing the impact that making changes in one part of the system can have on all other parts of the same system and associated systems, not understanding that changes at home are reflected in some way at work, and on and on, can be the sources of failure for change initiatives. Technology leaders must see the connectedness of changes and they must see to it that people stay connected during changes.

Change will occur whether it is led or not.

Change is part of existing—we can't not change! Changes can be planned or unplanned. Those which are planned require leadership and even those that are unplanned may call leaders to action as a result of their unplanned consequences. Leadership by its very definition involves change; and change needs leadership. Change and leadership are, in fact, two sides of the same coin. However, just because it can be done doesn't mean that it always should be done. Leaders must do more than just influence because they can. Leaders need vision and values guiding and influencing them as they are guiding and influencing others. Technology leaders are no exception.

Fullan (1991) asserts, ". . . implementation is the essence of change. . ." (p. 10) and, that, "It is one thing to know the events and situations that cause change or prevent change from happening; it is an entirely different question to know what to do about it" (p. 9). Likewise, Conner (1993) points out that, "Effective leaders are capable of reframing the thinking of those whom they guide, enabling them to see that significant changes are not only imperative but achievable. Yet the challenges facing these leaders go beyond determining 'what' needs to be done differently. They must also address 'how' to execute these decisions in a manner that has the greatest possibility for success. Leaders must keep in mind that the accuracy of decisions alone can never compensate for poor implementation" (p. 9).

The title of Conner's book, *Managing at the Speed of Change* (1993), hints at the technology leader's "need to know" about both the how and why of change. Technologies are changing rapidly—at a frightening pace to many. However, just because the technologies are changing rapidly this does not mean that their levels of use will occur at the same speed. In fact, the history of technological changes in education (particularly in classrooms) speaks to the need for technology leaders to become skilled change facilitators if integration of technology is to occur. In fact, as reported by Panasonic and AASA (1995), "Even districts that have drafted technology plans often have proposed only piecemeal approaches. They have installed a computer here or there for specific or limited purposes. Rarely have they established cohesive, sustainable systems." (p. 1)

What are the Implications of the Speed of Change for Technology Integration?

Frustrated and disappointed are feelings experienced by technology advocates and resistors alike when it comes to the speed of change for technology integration in schools. On the one hand, the advocates can't understand why the tools and their resulting consequences are not embraced and employed immediately. On the other hand, the resistors are saying "slow down—I haven't mastered the innovations you brought in last year, last month or last week. How can you expect me to worry about next week, next month or next year!" Add to this the history of integrating technology into education. Numerous disappointments have been experienced over the years—TV, Radio, programmed learning, language labs. The results for both advocates and resistors have been lots of promises with little pay off. According to Snider (1992):

> "With almost mechanical regularity since 1900, a series of new machines has appeared in the classroom and has been chronicled, albeit in footnotes, in the history of American education. Decade after decade these inventions are brought to school. Each deal with communication in one way or another, and each is supported by a cult of enthusiasts claiming that this particular machine is 'the most important development since movable type'. . . Some of these inventions were in the classroom for only a short time before disappearing without a trace." (p. 318).

Still, according to Falk and Carlson (1992) ". . . there is research to indicate that these interactive multimedia tools can enhance learning in the areas of acquisition of content, development of skills, efficiency of learning and satisfaction with instruction (p. 96). They go on to point out that the reasons for this lack of use and resulting minimal impact are many. Lack of financial resources and teachers' lack of knowledge are among them.

> As if an echo, Panasonic and the American Association of School Administrators (1995) identify the two major reasons that school systems have not done well in their technology applications as lack of experiences/knowledge and resources. First, they point out that educators have been so overwhelmed by the task of delivering knowledge that few have actually had personal experience with technology's advanced capabilities. This lack of experience prevents seeing the technology to teaching to learning connections. Secondly, they note that technology requires major infusions of capital—an unusual part of school district budgets. And when money is spent on technology, the communities would rather that it go directly to student instruction than on infrastructure that is so needed to support technology.

Cuban (1993), on the other hand, set forth a quite different explanation for why so few technologies have appeared so seldom in the daily existence of schools and classrooms. He acknowledges the usual excuses of not enough money, teacher resistance, and lack of support from the administration. He calls these "plausible, but ultimately superficial". Instead, he asserts that the reasons are related to school as organizations—that they are substantially different than other organizations, businesses and industries. His two reasons as to why schools have been less vulnerable to technologies than other institutions are: (1) ". . . certain cultural beliefs about what teaching is, how learning occurs, what knowledge is proper in schools, and the teacher–student (not student–machine) relationship dominate popular view of proper schooling"; and, (2) ". . . the age-graded school, an organizational invention of the late nineteenth century, has profoundly shaped what teachers do and do not do in classrooms, including the persistent adaptation of innovation to fit the contours of these age-graded settings" (p. 186). Cuban's identified influences will require changes in the organizational culture of schools and schooling to allow technology integration to occur. Changing the culture of an organization is complex and requires skilled and patient leadership.

Unfortunately, according to Panasonic and AASA (1995), "Most school systems do not know how to get information about the available technology, how to integrate it into practice, or how to pay for it. Nor do they generally use technology to guide organizational decisions, link instructional and administrative systems, connect to other professionals, or collect and retrieve information effectively" (p. 1). Some of this can be attributed to the sad history of successful change implementation in education. And, this less than stellar record of success is due in large part to a lack of knowledge and skills about change and the change process.

Whether it's money, training or a different organizational culture, changes well be needed if technology integration is to occur, Snider (1992) predicts ". . . that there will be more and more machines in the classroom. Technology will prevail. The problem that lies ahead will be—as it always has been—direction and control: direction of education in terms of its goals and purposes and control of technology in terms of its application." (p. 323) Technology leaders must become skilled in the change process if the organizational culture of schools is to be modified to make technology a part of the system rather than an intrusion in it. They will need to become and help others become what Conner (1993) calls resilient managers—those who have the capacity to absorb a great deal of change with little of no

demonstrated dysfunctional behavior. According to Conner (1993) resilient managers are successful with change because "Instead of viewing change as a mysterious event, we approach it as an understandable process that can be managed. This allows people to avoid feeling victimized during transition; it promotes confidence that change can be planned and skillfully executed." (p. 7) He goes on to say that ". . . winners enhance their resilience in part by approaching change as an understandable process with phases that can be anticipated and managed. They view change as an unfolding continuum and demonstrate a high tolerance for its ambiguity. They plan and execute movement architecturally from the present state through a transition phase to the desired goal. And their plans include pain-management strategies to help people disengage from the status quo as well as desirable and accessible remedies to attract them to the desired change." (p. 103).

Summary

Science, technology and change form a continuous link and have done so for centuries. Science (in it's broadest definition) produces discovery i.e., new information. New information empowers the development of new technologies (or tools) to use. New tools initiate changes (social, economic, intellectual, political). These changes can , in turn, generate new behaviors and new questions. The resulting changes influence everyone and require and/or produce new information. At this point, the cycle begins again—science to technology to changes. Much like the "Energizer Bunny", it just keeps going, and going, and . . . Rifkin (1980) writes, "Things don't just "exist" as some kind of isolated fixed stock. This static view of the world has been replaced by the view that everything in the world is always in the process of becoming. Even nonliving phenomena are continually changing . . . There is nothing smooth about the ebb and flow of the becoming process. It moves along in jumps and spurts" (p. 227).

Things may change but the process will not likely do so. Snider notes that "At this time, we do not know whether technology will be used to do more efficiently and more rapidly that which has always been done or to do totally new things. "However, he continues with, "Most important, technology must be used to educate people who can think for themselves, people who will not be servants of the machine in the classroom."

Technology leaders must know about change and the change process if the power of technology to reform and restructure is to be released. Technology leadership is change leadership. Technology leaders need to remember that the only thing that is ever really going to change schools is people. Therefore, they should focus on the people—the technology will progress on its own—it is people who need and want leadership to help them with both change and technology.

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Educational technology places new demands on school leadership. Those in leadership position will have to be technically literate and in the forefront of the technology revolution.

TECHNOLOGY LEADERSHIP: Moving Beyond the Photocopier

Paul C. Martin

A recent survey by the U.S. Department of Education, 84% of America's teachers consider only one type of information technology absolutely "essential": a photocopier with adequate paper supply (Telecommunications Policy Review 11/6/94, p. 1). Much rhetoric in the press and halls of government on the need for improving the American educational system has occurred in the 1980s and 1990s. Educational improvement has generally taken two approaches: (1) patching up or adding to the existing practices, and (2) designing a new model of schooling. The first approach came about as a reply to *A Nation at Risk* (National Commission on Excellence in Education, 1983). This type of reform was based in the assumption that the American system of education was providing graduates not capable of competing in the global work force because schools had become lax in their practices. Increased graduation requirements, increased formal educational requirements for teachers, more student homework, longer school days, and longer school years were among the recommendations for improvement. This effort for change was applied in improving how the teacher currently operated in the classroom rather than on adapting to teach the varied way students learned. The way classrooms operated changed little; the textbook remained the basic unit of instruction, instructors were the gatekeepers of knowledge and used "chalk and talk" to convey information to students, curriculum areas remained isolated from each other and most often from relevant application.

The second type of reform for the American educational system used the term restructuring popularized by *A Nation Prepared* (Carnegie Forum on Education and the Economy, 1986) and the Coalition of Essential Schools (O'Neil, 1990). The restructuring concept includes emphasis on the idea that most American children are capable of learning at dramatically higher levels of performance, student-centered learning with student understanding given precedence over content coverage, and measurement of learning in terms of performance in authentic settings rather than the scores produced on standardized tests.

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The use of emerging technologies has been a logical component of both of these movements to improve education. The U.S. Congress Office of Technology Assessment (OTA) has noted that educational technology has provided a strong catalyst for reform and projects that technology can be the key to higher levels of achievement by students (1988). The Clinton Administration supports the formation of information infrastructure to connect government, education, health safety, etc. (Vice President Al Gore, speaking to communications industry leaders, January 11, 1994). To this end, schools have been implementing computer and related technologies into curriculum and delivery models. A survey in 1993 by Princeton Survey Research associates found that computers were installed in 52% of U.S. public classrooms, televisions were in 41%, but only one-half of the televisions were accompanied by videocassette recorders. ("A technology revolution," 1994) The Software Publishers Association reported that expenditures on technology products by educational institutions increased from $1.785 billion in the 1991–1992 school year to $2.427 billion in the 1993–1994 school year ("Learning a costly," 1994).

These movements toward educational improvement have produced enhanced performance on traditional skills, however work today does not simply require more or less of the traditional education skills. The world in which today's adult worker lives is very different than their parents' or grandparents'. Children schools' are today teaching for a world drastically different than the one they now live in. Projections vary, but most futurists project that the world's base of knowledge is doubling every two to three years (McCarthy, 1991). Job skill requirements have changed at a rate four to five times faster than curriculum and organizational changes in our schools, leaving a gap between what students learn in the classroom and what is expected of them in the workplace. (Daggett, 1992) When today's students enter the work force, they will more than ever in history be required to learn new skills to survive. In the 1990's and beyond, people are expected to change careers every ten years on average and a recent survey shows that only thirty percent of workers intend to hold the same job five years from now (United Way, 1989). These predictions are already being felt and the American public has been voicing more concerns about the effectiveness of the American educational system to prepare graduates for the new world of work.

Levine and Lezotte (1990) outline strong administrative leadership as one of the correlates of effective schools. Fullan and Stiegelbauer (1991) emphasize the role of the building principal as an agent of change. It will take strong district leadership to transform education to a delivery model that incorporates the present world knowledge base to prepare today's students for their future work-world life.

What will a district technology leader need to know to empower the district to transform the educational process to utilize more informational technologies than the photocopier full of paper?

School districts involved in transformation to a technology learning environment that provides graduating students with working skills for the information-age will be required to have, or gain, the competencies addressed by Gerald Bailey's article on Technology Leadership. An individual technology leader for a school district, however, cannot be expected to have expertise in all ten button areas, but must have a firm understanding of the four P's of technology leadership: (1) purpose, (2) public relations, (3) preparation, and (4) power. These four competency areas do not stand alone, but encompass many skills that must be intertwined as a technology leader helps empower his/her school district to transform curriculum and delivery to provide students with an information-age education.

1. Purpose

A district technology leader must be ready to lead his/her district in preparing a vision or mission for educational transformation.

Technology leaders must work for school transformation with a purpose. School improvement with technology learning is more than putting computers in classrooms. A technology leader must have an understanding of technology learning and its role in the transformation of classroom learning in school improvement. The implementation of emerging technologies must be blended with a vision of the final product to be produced. The mission is to prepare students for a future of life-long learning. District technology leaders need to have a background in learning theory, authentic, relevant curriculum and delivery to develop implementation plans for emerging technologies. They must blend the school improvement process into a functional operating process that addresses improved student learning.

2. Public Relations

A district technology leader must possess knowledge of the change process and communication and interpersonal skills to prepare the schooling community for the changes associated with technology-based learning.

In 1970, Alvin Toffler defined future shock as the shattering stress and disorientation that we induce in individuals by subjecting them to too much change in too short a time. Since the changes that have occurred in American education in the last one hundred years have done little to change the model of the teacher as the gateway to knowledge, the implementation of strategies that put the learner in charge of learning is bound to produce future shock in the community and the school. Just as the need for districts to have technology leaders prepared to direct progress toward the 21st century was addressed at the start of this article, those district technology leaders must be prepared to communicate and "sell" the vision for technology's role in improved student preparation to the important target groups. They must understand the correlation between research on how learners learn and the transformation of curriculum and delivery. Technology leaders need skills for communicating the vision of the changed produced curriculum and delivery using emerging technologies to all affected groups.

3. Preparation

A district technology leader must lead the school district in preparation of strategic and short-range implementation plans that blend the areas of school transformation with technology learning process.

Many school districts have not planned for implementing emerging technologies that encompass all the areas of school improvement. Lumley and Bailey (1993) liken many school district plans for implementation of technology as rudderless ships. As an educational change agent, the technology leader must be prepared to lead the district toward the development of plans for improvement that blend changes in curriculum, teaching and learning delivery, emerging technologies, and staff development into a system that will provide the students a quality education.

4. Power

The most important competency the technology leader can have in leading the school district in transformation is the ability to mobilize the power bases of the school district and community.

"The classical definition of power is the ability to get others to do what you want them to do" (Hoy & Miskel, 1991, 76). To truly be in a position to institute change, a technology leader in a school district must operate from a position of power. That power does not have to be inherent with an administrative position, but may come from acknowledged expertise and competence or personal trust. Technology leaders in a position of power must have the ability to interpret the formal and informal bases of power within the school community and work with these people to expand the power base of the school improvement team to operate toward change. Little gain from all of the expertise associated with the ten buttons of technology planning and implementation can be made without having support of the "movers and shakers" of the school and community.

One of the main complaints from people involved "in the trenches" of school reform is the availability of time to research and prepare for implementing change. Manipulation of school time tables can increase the power base for transformation. By looking at the system in new ways, many school districts have adjusted the schedules to allow common planning and teaming times giving school personnel an opportunity to be involved in in-service and collaboration on a regular basis. These types of adjustments allow school personnel to increase their power in the change process and increase the probability of creating permanent change.

How do technology leaders acquire the skills needed to instigate and initiate technology learning in school improvement?

School leaders need to model life-long learning and stay informed of learning and technological research and innovation. There is also a need for networking with others who are involved in similar practices of school improvement and technology implementation. There are many resources attainable from the Internet, educational journals, technology and school improvement conferences, university educational staff, and from discussion with others involved in the process. There are more and more individuals involved in implementing emerging technologies into school districts. If those involved will use the communication technologies available, all of these people can be collaborative partners in acquiring information to aid in improvement of our school systems.

If school districts are going to move to a system of curriculum and delivery that will truly prepare students for the world they will face, the people in leadership roles must make the effort to stay informed and continue to increase their abilities to direct planning and implementation in the direction of improved student learning. We must direct our school personnel to the availability of informational and instructional technologies and methods beyond the photocopier full of paper.

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The building principal has been identified as one of the key figures in any successful educational change. This is no less true in incorporating technology into the school environment. Principals, if they are to effectively serve as leaders of their buildings, must also be able to effectively lead by sharing the vision and demonstrating with technology.

The Principal as the Technology Leader

Ken Stanage

Is your building getting new computers or other related technology? Would you like to be a leader, riding the technology wave that is rolling across the educational landscape? Are you a principal who understands curriculum and instruction, but would just as soon leave the technology to someone else? If you answered yes to any of these questions, read on!

If your building is getting new computers or related technology, this article will help you lead the effort to use these new tools productively. If you want to ride the technology wave instead of floundering in the surf, this article can show you how. If you feel competent with curriculum and instruction, but shy away from technology, this article can help you utilize your curriculum and instructional expertise toward a leadership role in technology.

I will identify four key skill areas that principals must address if they are to become technology leaders. Additionally, I will offer suggestions for developing each of these skills.

Taking the leadership role in technology-oriented activities is paradoxical. On the one hand everyone acknowledges a strong leader. On the other hand, quality individuals do not like to be told what to do. Quality individuals like to have a say in not only the way things are done, but what the final outcomes ought to look like. Finding a leader who can manage this paradox is not always possible. However, there are things that an individual can do to foster the characteristics needed for this type of leadership. That is what this article is all about. In this article I will identify the characteristics of principals who are strong leaders in implementing and maintaining technology initiatives.

There are four key skills that are characteristics of all strong building level technology leaders. These four skills are: 1) Making learning the leader's primary objective, 2) Creating a learning organization, 3) Managing both the technology effort and the human development effort, and 4) Understanding the leader's role as designer. These four skill areas overlap and contain a number of interrelated constructs that make the leader's role a systemic phenomenon. Each of these skills will be examined to create a picture of the principal as a technology leader.

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Making learning the leader's primary objective

All leaders must be learners. In technology efforts, this aspect of leadership is even more important. What is the most rapidly changing part of any organization? It is always technology. New hardware, new software, new networking capabilities, new projection and presentation techniques, are just a few of the myriad of technological changes that occur constantly. The leader cannot be expected to master every piece of hardware or software that exists in the building. He or *she can, however, learn to master the hardware and software related directly to his or her work.* Make no mistake about this: an administrator who is constantly encouraging others to use technology and is supportive of all technology efforts within the system, while at the same time, avoids any changes in her own behavior regarding technology, is sabotaging her own efforts. Technology and its uses must be an integral part of the leader's plan for personal mastery (Senge, 1990). Failure to do so will endanger all future technology efforts in the district.

Creating a learning organization

Following closely behind the skill a leader must have as a technology learner, is the skill the leader must have in creating a learning organization. The leader's skills in technology may be appreciated and even admired by the staff but if the leader ignores the learning culture of the building they will find themselves leading a very short parade. Creating a learning organization is somewhat of a misnomer. An organization cannot learn. The people within the organization must do the learning. Creating a learning organization means that the leader must be skilled in cultivating the culture of the building so that learning becomes a high priority. The idea of continuous improvement goes hand-in-hand with organizational learning (Fields, 1993). The leader must develop skills in surfacing current mental models, demonstrating present practice, and describe the vision that illustrates the best practice.

Surfacing individuals' mental models is difficult and "touchy," but it must be done. Mental models can be thought of as perspectives, frames, or even paradigms through which individuals filter information (Senge, 1994). The mental model colors all experiences, memories, and facts with the subjective reality of the individual (Fullan, 1991). The leader's task is to help people cut through these perspectives using data, information, and experiences.

Assessing current reality is tough. Everyone talks about the "bottom line" but no one likes to do much about it. Schools are notoriously bad at avoiding current reality (Schneider & Houston, 1993). The preference has always been to blame poor performance on the system and let it go at that. The problems that reside in the system are never examined. The leader who wants to be effective must examine current reality and do whatever is necessary to get people to feel okay about examining test scores, observation data, survey results, etc. Anything the leader can do to supply data that reflect the objective reality is helpful. The key is to do it at a rate and in such a way that is tolerated by the staff (Conner, 1992).

Finally, the leader must provide a vision that reaches to the future and pulls current reality into it (Lynch & Kordis, 1988). The leader's skill at painting an accurate picture of current reality must be balanced with a similarly accurate picture of where the leader sees the organization moving. This vision should be shared by all. Sharing the vision, means that every

person should be able to see their own subjective vision within the organization's vision. The simple vision of all children learning is a powerful one. If acted upon by the leader regarding the teacher's personal mental models, current reality, and a vision for the organization, these forces will coalesce into a powerful mission. This mission should form the core of any technology effort.

Managing both the technology effort and the human development effort

When leading a technology-oriented venture the leader must keep two change efforts in mind. These two change efforts are: 1) the technology effort, and 2) the human development effort.

The technology effort must include not only the hardware, software, and network plans but also take into consideration the human development factors. Technicians can tell the leader how to choose what type of hardware and network to use; if the leader can describe what is to be accomplished with the system. Teachers and software vendors can point the leader to sufficient software titles to install in any system; if the leader knows what is to be accomplished with the software. In many cases the missing ingredient in both situations is knowledge. Often, the leader does not understand what the hardware and software will be used for, specifically. This is not a problem if the leader's philosophy and the technology infrastructure in the building are compatible.

If the leader's philosophy regarding technology is that technology is to be used for drill-and-practice instruction only, or that teachers will only use technology to write letters and to submit grades, the technology infrastructure will be considerably different than in a system where the leader sees technology as a tool to augment all human capabilities. I favor the use of technology as an augmenting tool and believe that school leaders have the obligation to use the technology to assist organizational learning through the augmenting of teams and individuals. It is for this reason that the second effort is so important: leadership in human development.

If the leader ignores his or her own learning, fails to cultivate the learning organization, and decides to limit the use of technology into easily controlled boxes (drill-and-practice, grades, etc.) he or she, will not see a need to worry about human development. The human development effort is the most important aspect of any change plan and requires the leader to have skills as a designer.

Understanding the leader's role as designer

Trying to infuse human development into a system that requires no development whatsoever is a futile activity. Organizations have a way of shedding all the baggage that is not assessed, valued, or scrutinized (Morrisey, 1992). If learning is not valued by the leader nor encouraged and expected from the staff at the outset of an initiative, it will do little good to expect it later. This aspect of the change process must be planned and designed from the beginning (Boar, 1993). However, may not be enough. If the organization is designed to take orders it may not be enabled to ask questions. If the organization is designed to be reactive it may not understand the language of a proactive leader (Covey, 1992). These issues call for the leader to redesign the organization on the fly and to make sure that these opportunities are designed into new plans (Bridges, 1991).

The leader as designer is a multifaceted phenomenon. One aspect has to do with the leader's familiarity with all kinds of technology and education integration. The principal must be a master of the change process, technology planning, staff development, curriculum, and learning principles. The principal who leads technology efforts must additionally have access to people who understand technology issues regarding safety and security, hardware infrastructures, and technical support needs. Finally, the principal who is striving to be a technology leader must honor the ethical considerations concerning copyright laws and other hardware and software issues.

IDEAS YOU CAN USE

Ideas For Making Learning the Leader's Primary Objective

1. Always be on the lookout for new software to learn and let the teachers know you are learning it.
2. Select a software title and request volunteers to learn how to use it.
3. Confront yourself:
   a) Complete a leadership style inventory,
   b) Complete a learning styles inventory,
   c) Examine the results closely and confront your own current reality,
   d) Set goals or modify your learning plans to fit your style,
   e) modify your leadership style to fit the personnel or situation.
4. Make a public proclamation that you are now committed to learning.
5. Read. Begin with the references in this article and expand. If you don't understand a book, read it anyway. A year later, pick it up again and you'll be pleasantly surprised.
6. Realize that effective, long term learning is not an overnight experience. It takes time but you can be encouraged by the fact that sudden breakthroughs occurs with more frequency as you read and study for longer periods of time.
7. Turn the television off or put it where you can't see or hear it. Learning must be a real priority for you, not merely a show for your staff.

Ideas For Creating A Learning Organization

1. Read Peter Senge's, *Fifth Discipline*, (1990), Chris Argyris, *Knowledge for Action* (1993), Nancy Dixon's, *Organizational Learning Cycles* (1994), and Kline and Saunders, *Ten Steps to a Learning Organization* (1993).
2. Create a learning climate in your building by:
   a) Modeling your personal and professional willingness to confront current reality.
   b) Finding ways and using opportunity to confront the staff with current reality.
   c) Making another public proclamation that the building is now safe for thinking and everyone is free to take intelligence risks. Furthering the new belief in that everyone is capable of learning anything and that every situation can be improved.
   d) Reinforce the staff that supports the reframing efforts.
   e) Be consciously consistent. The perception that you are treating people different will kill you.
   f) If you have a tendency to use verbal put downs or habitually interrupt others before they have finished speaking, stop it. You may need to practice some behavior modification if you have a problem of this nature.
   g) Do something silly to promote the positive climate, but don't communicate that being positive is silly.
   h) Paradoxically, be spontaneous. Plan positive rewards and events, but keep them from being routine.
   i) Finally, examine yourself and how you respond to new ideas and opinions contrary to your own. If you find yourself constantly arguing or disagreeing, your search is over for the creativity blocker: it's you.

Ideas For Managing Both the Technology Effort and the Human Development Effort

Managing Technology and People

1. Have a vision.
2. Allow the vision to evolve.
3. Plan around the vision.
4. Cultivate others to co-create a vision when they are ready.
5. Never buy just what you need. Always buy more.
6. Don't measure the results of using technology until people know how to use it.
7. Measure what the technology effects.
8. Practice the 80/20 rule: Spend 80% of your technology budget on identified needs. Spend 20% of your technology budget on exploration AI, developmental, and what if, technology.
9. Do not argue about platform or operating systems. Purchase what you are allowed to and go from there.
10. Never refer to older computers as obsolete. Patrons and Board Members do not like to hear about the computers purchased three years ago as being obsolete. Use them to write, for accounting, or other areas where the technology is limited to a simple program or function.

Resolving Human Development Conflicts

Go for the breakthrough solution. Get out of the "win–win" mode of thinking where both sides concede and really view it as "lose–lose". Go for the elegant solutions: one that gives everyone what they want and enhances the organization at the same time.

Achieving an Elegant Solution

Achieving elegance is really a matter of "reframing" people's perspective on the situation causing the problem. What is needed is a leader who is skilled at helping people understand the resolution perspective. The resolution perspective is understanding which of the four perspectives you are using to view a situation. The resolution perspective is also useful when surfacing other peoples' mental models, so that they too, can see which perspectives they are using to view the situation. The five perspectives are:

1. Consensus Perspective
   People in this perspective are looking at the things they can agree on. The attitude is 70/100. We can agree on 70% of the issue but support 100% of the groups solution. Guiding question: Ask, what can we agree to?
2. Political Perspective
   People in this perspective are protecting personal or collective rights and are interested in power. The attitude is often all or none. We will not agree on anything that effects us in unpredictable ways. Small concessions are often made, while the larger issues are often stumbling blocks. Guiding question: Ask, what can be changed in the group's positions to make it more acceptable to others?
3. Empirical Perspective
   People in this perspective see themselves as being scientifically correct. That is, the empirical perspective is believing that one possesses the objective evidence to support a position and that all other positions will be of lower quality. People viewing situations from an empirical perspective may concede part of their position but will rarely support the conclusion. Guiding question: Ask, what quantitative data supports the group's position?
4. The Ideological Perspective
   People in this perspective are on a crusade. They believe like the holder of the empirical perspective that they are right, but for a different reason. These people believe that they are right because their faith tells them they are right. Often the ideologist supports assertions with "empirical data" in an attempt to legitimize their faith. You must be careful with ideological perspectives. Ideologists are usually on two missions: 1) They are out to convince the world that their faith is correct and true, and 2) They are out to convince themselves that their faith is correct and true. Guiding questions: Ask what modifications do we need to make in the group's position to make it palatable to people's beliefs? Is this a belief issue?
5. The Rational Perspective
   People in this perspective are single minded. These people are find out what the best solution is and do it. This is obviously the perspective that holds the most promise for unfettered problem solving. Leaders who can get the group focused on what works are in an excellent position to move ahead. Guiding questions: Ask, what do we need to do right now? What do we need to do next? What is going to work?

Managing the numerous conflicts and complex situations that arise with people interacting with technology requires the leader to understand the various perspectives people bring to the table. The leaders success will depend on developing skills in using questions and thought ladders to broaden and change perspectives.

Ideas For Understanding the Leader's Role as Designer

By designer, I am referring to the leader's role as the shaper of the building technology use and the leader's ability as a change agent.

Shaping Technology

Understand curriculum and match it to the technology. The limited research on instructional technology and student learning indicates that instructional technology shows clear benefits for: 1) simulating outcomes too dangerous or expensive to experience in life, and 2) literature review and data collection.

Do not ignore drill-and-practice software that enhances declarative knowledge. Select quality drill-and-practice software that supports worthwhile declarative knowledge. Multimedia is a great tool when used appropriately. It should never replace writing. Multimedia should encourage writing. The combining of graphic, sound, text, and motion are both thrilling and informative for students and teachers.

Multimedia has great potential for students and teachers to build products that enhance learning. The difficulty is in the steep learning curve of the technology that must be mastered. Teachers and students must deal with both course content and the nuts and bolts of the technology to be used. Is the time spent learning the nuts and bolts justified? It can be, if the technology is used appropriately.

Change Agent

Following are some general principles taken from the research regarding the literature on successful organizational change. They have been arranged sequentially:

In one to two years:

1. Be visionary and share the vision.
2. Be concrete/sequential in planning and implementation during the initial changes.
3. Be very directive in the beginning.
4. Produce something quickly.
5. Build trust.
6. Celebrate progress that is measured.

In three to four years:

7. As people begin to share the vision, become less concrete sequential.

8. Begin meaningful dialogues by discussing mental models and current reality.
9. Be less directive and more facilitative.
10. Agree on outcomes and find people to design processes.
11. Be wary of setbacks (usually caused by jumping from step 1 to step 8!)

Conclusions

The information in this article is intended to assist principals in becoming technology leaders in their buildings. The "What to do," section of this article contains suggestions and activities that principals can utilize to reach this goal. Becoming a technology leader is a difficult and time consuming endeavor. Mark Twain said, "A man who carries a cat by the tail learns something he can learn in no other way." Unfortunately, this homely is true concerning your tutelage as a technology leader as well. There will be times when there is no guidance available and the school of hard knocks is the only teacher in town. The key is perseverance. I am confident that if you strive to learn continuously, foster organizational learning in your building, experiment and utilize technology appropriately, and become a student of the change process, you will successfully ride the technology wave and overcome the difficulties that lie ahead in your quest toward technology leadership.

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School facilities have largely been designed for limited technology; usually chalk boards and overhead projectors. New electronic, educational technologies require architects and school administrators to rethink school planning for the effective use of educational technology

Impact of Facilities on Technology Leadership

Kenneth E. Lane and Dwight P. Sweeney

The use of technology in the classroom has become a major educational consideration in both student learning and evaluation of leadership effectiveness. While there is a belief that the use of technology will improve the delivery of knowledge to students, questions regarding the impact of the facilities on technology continue. Why are physical facilities critical to providing technology leadership? What must technology leaders recognize and understand about facilities? What is the role of human factors engineering? Are technology-related infrastructure issues the same for all leaders in all situations?

Technology goes beyond having computers in the school. Technology implies that there is flexibility within the facility to conduct interactive communications for learning whether that be within the school, region, state, nation or world. It also implies that there is a willingness to incorporate new discoveries into both the curriculum and facility.

Physical Facilities and Technology Leadership

Technology within the classrooms of our schools is generally limited to the computer station. A few school districts have developed classrooms for the future by installing technology that permits the use of telecommunications for long distance learning. By long distance learning, we mean any learning situation in which the teacher and learners are physically separated from one another. Although self-directed lessons prepared for print, audiotape or videotape may be considered types of distance learning, the use of electronic technologies to connect the teacher at one site (the home site) with learners in one or more other sites (remote sites) are now considered the primary tools of distance learning (Tri-College University, ND).

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Classrooms tend not to have computer stations for each student. When there is a computer within the classroom, usually it is not a current model, not networked to the other computers in the school and does not have access to a phone line for accessing the outside world. Even computer labs within the facility endure these same problems.

Regretfully, school district finances play a major role in the use of technology. Schools are destined to use obsolete computers without adequate funds to continually replace them. Thus, efficiency lags as does the ability to use newly developed software which is directed to the new operating systems rather than the old systems.

These limitations begin to answer the question of why the physical facilities are critical to providing technology leadership. In reality, however, they do not address the question. They only defend the lack of instructional priorities and the lack of facility planning.

Technology leaders must begin to demand school facility retrofitting which will provide students with access to technology and technology services. Technology must be integrated into the school facility; it should not be a stand alone course to be taken by students. The school facility is an instructional tool first. It must be adaptable to facilitate new educational programs. There must be standards in place to help determine the benchmarks for the school facility (Stewart, 1989). If one of the benchmarks for the school facility is the integration of technology into the facility and the curriculum, then the planning of our schools facilities must enable us to accomplish this goal. Planning has to occur before the technology is implemented. The leadership in our schools has to recognize the message being sent to parents and the community. When facility planning does not occur, the message is that student learning is not important.

The school facility must physically allow for the appropriate use of technology in curriculum and assessment. The California Department of Education (1990) states:

> Using appropriate technology necessitates changes in how teachers teach and how students learn. Instead of being dispensers of knowledge, teachers will become facilitators of consultants. Teachers will benefit from technology by increasing their knowledge of a subject as they learn with their students. Perhaps the greatest advantage of technology is its potential for customizing teaching methods to fit the individual needs of students and allow them to study at their own pace.

If the technology leadership in our schools believe this, then the demand for retrofitting our school facilities to enable students to access technology will have to become the first priority.

Understanding the Impact of School Facilities

Making do with the present school facility is not acceptable. Simply placing computers on tables or desks is not an appropriate response. Students come in different heights with different eye sights. One common standard is insulting to the student learner. The use of technology ranges from computers at the student's desk to computers at the student's home which will interface with those at the school and at commercial computer online services. Regardless of the variation, the issue of how this interactive network will be incorporated into both the curriculum and the school's design must be addressed.

Maybe the answer is the accessing of classes from the student's home where accommodations tend to be more personal in nature and function. This demands a school which is a server for accessing information rather than a physical facility.

Brubaker (1989) discussed the impact of technology on the philosophy of our schools when he advocated the "community school" to enable residents to more frequently use school facilities and students to use facilities throughout the community. Schools leaders should promote the concept of the

"community school". Partnerships with government and business to use the technology in their facilities rather than duplicate them within our schools should be given serious consideration. However, some barriers to such partnerships need to be considered. McNeil (1990) defines the barriers and issues which impede usage of technologies:

1. *Technical barriers:* They cover the lack of standards and technological incompatibility. For distance learning, there are two inherent problems: providing the student with sufficient educational resources, and providing timely feedback from the teacher to the student.
2. *Structural barriers:* They include budgeting policies, lack of incentives, lack of training or technical support, poor support service, financial resources, access or disproportionate access, extra time it requires to use technology, and underutilization.
3. *Attitudinal barriers:* They focus on human aspects and various forms of faculty resistance to public exposure and off-campus learning, plus poor marketing conditions.

Perhaps it is time to revisit Hawkins & Overbaugh (1988) when in explaining the interface between the school facility and learning, they stated that "a school building must do more than simply house the instructional program. Perhaps instead the facility should be viewed as part of the program." The same is true for technology. It must be viewed not as an end in itself, but as a part of the program.

Human Factors Engineering

The impact of human factors engineering is a concept that must be understood by technology leaders. However, the professional literature and research in this area is minuscule (Robertson, 1992; Knirk, 1992; Hathaway, 1988; Taylor and Gousie, 1988). There is little information on human factors engineering as it relates to the school setting and student learning, especially in the area of student furniture for creating the best possible physical learning environment.

When Lane and Richardson (1993) contacted five major school furniture manufacturers in the United States, two questions were asked of each furniture representative. The first question was: What research does your company use to design furniture for schools to optimize student learning? In each instance, the response was that they did not rely on research but upon specifications from the American Furniture Manufacturers Association and the National Standards Board to decide seat width, belly room, and prohibited combustible materials. The second question was: How are design decisions made regarding school furniture? The predominant answer was that designs were basically unaltered for years and that designs reflected what schools want in furniture.

While there is a temptation to charge school furniture manufacturers with selling furniture without any research to validate design, that would be unfair. They simply manufacture what the customer wants. In this instance, the schools in this country keep ordering the same furniture that has been ordered for the last 25 years. There is also a temptation to blame the schools for this development. However, schools generally do not have the research budget or personnel to address furniture design change. Changes usually occur as a result of experiences schools have with students and teachers.

Clearly, for technology leaders, the issue of human factors engineering in the design of furniture for students needs immediate attention. The first step in this process is for school furniture manufacturers and technology leaders to begin a process of evaluating how education is going to be delivered in the future within both curricular and design boundaries. The tunnel vision of "lets buy what we always have because it works" and "lets keep manufacturing it this way because it sells" is fundamentally flawed because it does not address the most important question in education—what is in the best educational interest of the student?

The second step is to conduct research regarding the best furniture design to enable teachers to better teach and students to better learn. If the furniture we are placing in our schools does not accomplish that end, the effective use of technology to improve both the delivery and receipt of education is an unattainable dream.

The third step is to study the broader issue of human factors engineering as it relates to the total school environment. Furniture is a part of it but so also are lighting, colors, ergonomics, space, temperature, air quality, flooring and security. The question of how furniture harmonizes with those additional aspects should lead us into better methods of delivering a better educational system through the use of technology.

Infrastructure Issues

Technology leaders confront different physical situations as well as different student needs. For instance, physically disabled students have the same right to an appropriate physical learning environment as any other student. The *UFAS Accessibility Checklist* (1990) outlines many of the physical requirements that must be met by schools. As an example:

> Classrooms must have aisles at least 36 inches wide. Objects mounted to the wall inside a classroom must have bottom edges 27 to 80 inches above the floor and project no more than 4 inches into accessible space. The floors must be slip-resistant and have a level change of no more than ½ inch unless ramped. Signs identifying the rooms must be mounted on the wall at the latch side of the door between 54 and 66 inches above the floor. The characters must be raised 1/32 of an inch and be between ⅝ and 2 inches tall. Seating spaces for students in wheelchairs must have a 30 × 48 inch area of clear space. The knee space must be at least 27 inches high, 30 inches wide and 19 inches deep. The top of a work table must be between 28 and 34 inches from the floor. Additionally, electrical switches and receptacles and thermostatic controls must be between 15 and 54 inches above the floor on a parallel approach and 48 inches on a forward only approach.

Differences should also be recognized in terms of the age and the learning objective of the student. Elementary children have different technology needs than does the high school student. Likewise, a high school student analyzing data would need different software and hardware than an elementary student reading an interactive story on the computer.

The infrastructure must be evaluated in terms of its ability to be wired with optic fiber, to have cameras and microphones mounted within classrooms for distance learning and to house a local area network. The use of local cable company access and equipment within the facility must be addressed. While addressing these issues, the wiring and communications standards of the state and the building codes of the community require strict adherence.

Summary

Technology leadership requires an understanding of the impact of the facility on the use of technology, the role of human factors engineering in using technology effectively and the changes that must be made in the infrastructure to integrate technology into both the facility and the curriculum. The ability to integrate both an understanding and the application of technology into the facility is integral to technology leadership. It is only with effective leadership that our teachers can better teach and students can better learn.

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It has been said the "school facilities are educational philosophies set in concrete." As information technologies allow innovative methods of learning, facilities must adapt to meet these new capabilities. Generic classrooms, designed for an educational era of low technology will no longer be sufficient. This article provides a glimpse of how classrooms may be structured to meet different learning styles.

THE FUTURE OF CLASSROOM DESIGN: Integrating Technology and Instructional Methods

Bill Bridges

Integrating Technology and Instructional Methods

Designing a School

Recently I was invited to participate in a new schools design study group. The group was asked to provide the educational requirements for interpretation by architects into three new school buildings. The group spent long hours discussing restrooms, offices, teacher's furniture, classroom size, and a myriad of details. Technology installations received their share of discussion including types of systems, how many, and how they should be made available to students. The document that resulted from these discussions (USD 501, Topeka Public Schools series) was lengthy and detailed concerning the educational and technological requirements for the schools. The study was then turned over to the architects for their rendering of a school building. Although three new schools were being built—a computer science magnet, a natural science magnet, and a "traditional" school—to save money, they were to be carbon copies of each other. The architect at the direction of the District and in consultation with the design study group, presented a floor plan using all the current considerations for building schools. The classrooms were identical in size and shape, facilities in each classroom were the same, and the classrooms divided into pods separating students into primary and intermediate age groups. As the detailed building plans progressed, technology was integrated into the classroom based on a single decision; all teachers would use a collaborative learning method of instruction.

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Reviewing the Experience

Although its too late to make changes in the foregoing design process, a review highlighted several areas that were not considered or were driven by the wrong priorities. First, the technologies were planned using the "blanket" approach—every room would have the same technological capabilities. While this approach is not necessarily bad, it takes no account of varying instructional methods and the technologies that best support them. It caters to the "one size fits all" school design principle. This "blanket" approach for technology was supported by another "blanket" decision—the collaborative learning instructional method was best and all lessons would be taught in that manner. Notice I have never mentioned curriculum. The instructional method was determined without any thought for curriculum. In fact, curriculum has yet to be written. Despite all the ongoing discussion in education forums concerning curriculum/technology integration, our group intrinsically based its technology decisions on an instructional methods decision.

Other failures in the design process included our relationship with the architect. The first of our failures was not asking the architect, before hiring, about his experience with installing technology in new buildings. My first conversation with the architects, besides perfunctory introductions, was "Who is your technology consultant?" to which I received the answer "We don't include technology in the design, you add that on after we finish building." After straightening out that misunderstanding, we continued to let the architect make educational decisions; the shape of the classrooms, their size, grouping by education levels, technological layout, and position in relation to the rest of the building facilities. That doesn't sound so bad until you realize that these are educational decisions in which educators played no part. Had we determined the curriculum first and subsequently the instructional methods best suited for each part of the curriculum, we would have been designing our classrooms and curriculum instead of the architect.

The results of all this review: instructional methods can and should affect classroom design, technology can support education better through specific application to instructional techniques, and curriculum should be the baseline for all decisions including instructional methods. Good curriculum includes varied instructional techniques which can be optimized with technologies implemented specifically to support them. Education needs to take control and build classrooms which facilitate learning through the integration of technology and instructional methods.

Classroom Design Standards

Architects have a number of standards they follow when designing buildings. Most of these standards involve building codes (UBC 1991) specifying square footage, lighting, ventilation, electrical wiring, etc. These are codes written by agencies who are concerned about safety for people. Technology has its own set of codes for wiring, ventilation, electrical emissions, and electric power (ANSI/TIA/EIA Series). These codes are concerned with equipment and environmental safety. When it comes to the design of classrooms the standards are extensions of existing building and safety codes. If we are to really design classrooms optimized for student learning, we must change our "code based" thinking about classrooms and adopt learning-centered designs. The following table summarizes some considerations concerning this change:

Concepts	Current	NEW
Classroom Size	32 sq ft per student—more for kindergarten and preschool.	Determined by the instructional methods.
Class Size	25, 28, or ?—depends on what the school board sets.	Variable—depends on the instructional method.
Curriculum	Can be taught in any classroom or a classroom special designed for the subject (i.e. chemistry).	Taught in classrooms designed for instructional methods that maximize learning—integrated.
Class Organization	Teacher has absolute control of learning—good order and discipline—follows curriculum guide.	Teacher guides students—students participate in the process—flexible curriculum.
Instructional	All methods can be used in the same classroom design with the same equipment—all teachers can use any and all instructional methods.	Instructional methods best used in classrooms designed to optimize the strengths of each—technology infused.
Learning Styles	All student learn "best" with the specified by the curriculum or the teacher.	Each student has a "best" learning style which can be accommodated in a technology-infused classroom.
Teachers	A personalized environment improves the teacher's ability to teach.	An instructionally optimized classroom using technology allows every classroom to be personalized.
Students	Require a fixed schedule—same room, same teacher for each subject—unable to cope with change.	Cope with change better than teachers—optimal classrooms allow the student to learn better.

In 1973, Stanton Leggett defined a planning process for designing new schools (De Chiara & Callender (1973)). In his article he promoted the idea of flexibility and change for school buildings. The concept was that classrooms must be designed to undergo continuous change responding to continuously changing educational programs—"don't tie education down." This concept has influenced architects and educators for many years. It insures a continuation of the "cookie cutter" architecture for schools—the one size fits all classroom which can later be changed to another one size fits all classroom. In one respect Leggett was right—educational programs appear to change frequently. Education has now run head on into something that changes faster—technology and educators have been asked to incorporate technology into the curriculum.

A Necessary Technological Aside

For purposes of this paper, it is necessary to define technology as it will be used in the remainder of this discussion. Technology will be defined as electronic tools resulting from the invention of the microchip which can be used for learning and instruction. In general, they fall into the categories of voice, video, and data systems, or combinations thereof. Older technologies such as telephones, audio-visual systems, and mainframe computers which now benefit from or have become dependent on microchip technologies are included in this definition.

Curriculum/Technology Integration

Education has been asked to "integrate" technology into the curriculum. In most cases, we have "associated" technology with curriculum. We perform the same educational functions using technology and have made the teaching of technology skills its own subject. We really need to treat the technologies themselves as tools and integrate the "results" of technology (i.e. information and communication) into the curriculum. This view assumes that like "crayon 101" and "pencil 101", "technology skills 101" and "technology skills 102" will be taught at the appropriate times in the curriculum to provide students the skills they need. Why discuss this in a paper about the future of classroom design? It allows us to free the curriculum from a hardware/software orientation and concentrate on assisting teachers and learners by using technology to optimize classroom designs benefiting instructional methods.

Technology Designs

Our approach to date has been to incorporate all technologies, or as many as we can afford, into every classroom. We do this because we never know what instructional method will be in use at any given time and our classrooms must be as flexible as possible. While not necessarily "bad", this is a costly way to use technology and our classrooms are still not necessarily optimized to leverage instructional methods. By designing our classrooms for instructional methods integrated with technology tools we can provide better environments for learning.

Some assumptions must be made concerning technology systems used to optimize classroom designs. First and foremost, learners must be responsible users. They do not abuse the technology. They understand its capabilities. Users must follow simple security measures regarding networks and software. They must also understand and abide by the legal uses of software. All technologies are part of an integrated schoolwide system. The core of the system is a network capable of voice, video, and data communications which accesses people, places and information for the purpose of education and learning. Finally, the concept of "technology space" is used to define how access is organized on the network. Technology space can be either private or public. It is a location in an information storage medium where users place information for their own or others use. We sometimes refer to these locations as home directories, personal folders, or public access folders or directories. Some of the technology systems used later in the classroom designs are neither mature nor cheap. They are real systems, however, and when used to fulfill specific educational functions make sense for learning.

Technology System Design

The technology system designs for schools should be heavily based on a central education network available to all students and staff. The network must accept data from various input sources such as keyboard and scanners, digitized video from a video retrieval and distribution system and voice from integrated telephone systems for voice mail and audio recording. The schools reference library must be accessible. The network must be capable of providing connection to the Internet as well as various commercial networks and bulletin board systems. All students and staff must be able to access it through remote node, remote control, or dial-in 24 hours a day. Only with this kind of access will students and staff be able to fully utilize the technology systems for instruction and learning. Each student and staff is provided access to a personal folder which contains their class notes and work. In addition, they can access group folders for each of their courses for access to common resources. This is the technology space mentioned earlier. It allows the students and staff to move freely from class to class and classroom to classroom always able to be in contact with their own teaching or learning information and information resources. The end of the digression.

Instructional Methods

Often referred to as teaching strategies (Smith 1971), instructional methods are the way in which information is presented to the student for learning. Realizing that no instructional method remains pure where student learning is concerned, I have selected six methods which are broadly agreed upon (Smith 1971) and for which classroom design and technology can be specific to optimize the instruction. The following definitions have been used to aid in focusing on the design and integration of technology for classrooms.

Classroom Designs

The following classroom layouts have been picked to enhance a particular instructional method. I have made no attempt to fit them together into a school building. The shape of the classroom, the arrangement of the furniture, and the technology used are products of experience and the help of architects (De Chiara and Callender 1973) who have set the standards for years. While it is easier to understand these designs for secondary schools or universities, there is applicability to elementary levels as well. In some cases the classroom will look familiar, but the technology implementation is new. In others, the design, furnishings, and technology will all be new.

Skills/Repetition

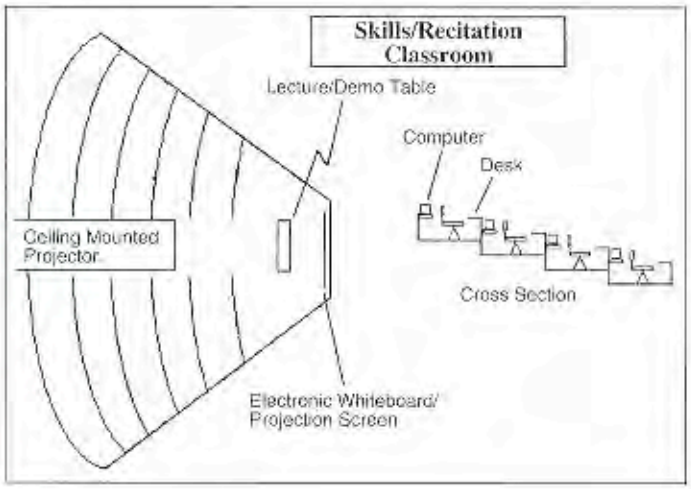
Repeated practice of a manual skill or mental operation to attain reflex response to a given stimuli. Although not a favorite way to instruct, the "drill & kill" method is often the best way to achieve a desired result (see Typing I or the multiplication tables.)

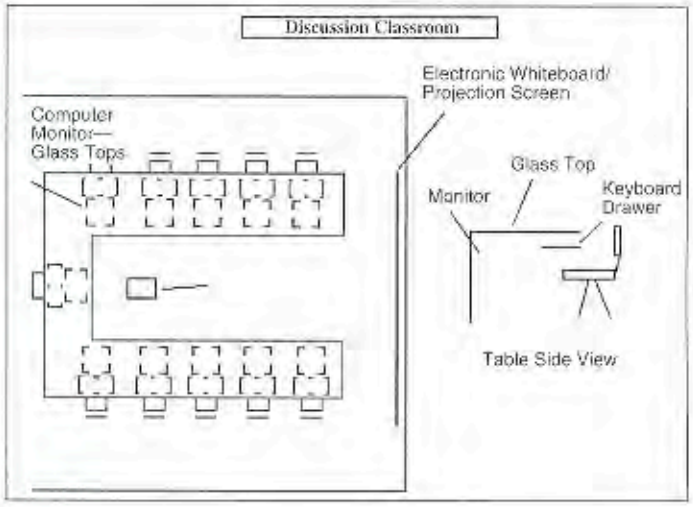
Design—Amphitheater seating, computers at the rear of each tier, screens facing the teacher, narrow desk space at the front of each tier—students face the teacher to receive directions and away from the teacher while working.

Technology—Electronic whiteboard, projector screen, suspended multimedia projector/sound system, each student has a networked multimedia workstation, teacher remote control system.

Discussion

Participation in a teacher controlled discourse to enable students to arrive at conclusions within a predetermined framework of knowledge. This usually takes the form of questions and answers by both students and teachers. It allows the teacher, who presumably has the most knowledge, to lead students into understanding of the subject and concepts under discussion. (English Literature 101).





Design—Rectangular shape, space for ten students and teacher—students arranged in a horseshoe shape for discussion purposes.

Furniture—"U" shaped table with glass top, computer monitors below glass with keyboard trays, open end of "U" faces display wall—teacher located at the head of the table.

Technology—Basic diskless student workstations for note taking, teacher with full multimedia capability, electronic whiteboard, projection screen, projector/sound system in ceiling, teacher remote controls for projection.

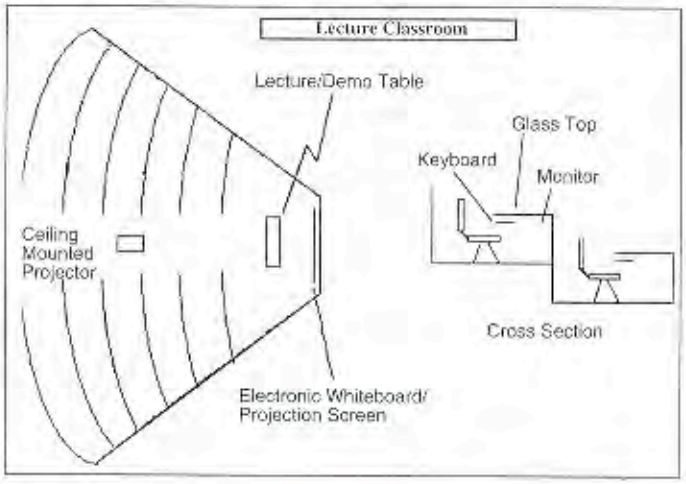
Lecture

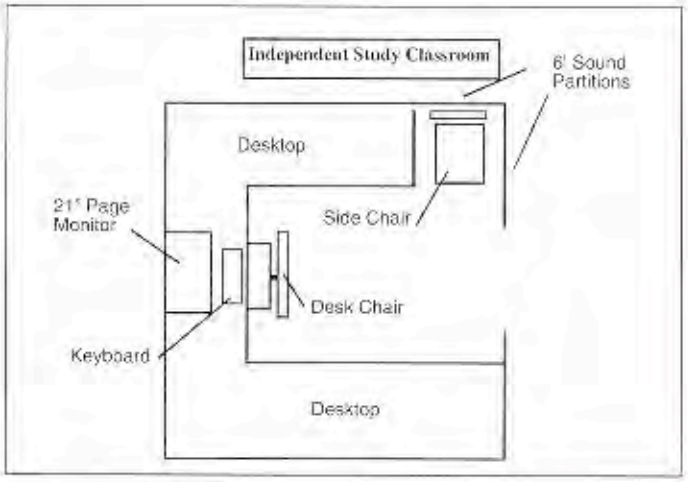
An information reception strategy. Lecture is based on the premise that the teacher knows the information and the best way to pass it to the student is to present it serially from start to finish. Active student participation is limited to responding to questions asked by the teacher to acknowledge receipt of the information. Although is some disfavor, this method can be very effective. Good lectures are almost an art form and may require more preparation than some other methods of instruction.

Design—Amphitheater seating

Furniture—Rows of tables with glass top, computer monitors below glass with keyboard trays—teacher faces students with wide lecture/demonstration table with computer monitor below glass top.

Technology—Basic student workstations for notes, teacher with full multimedia capability and remote mouse and keyboard, electronic whiteboard, screen, suspended multimedia





projector/sound system, vertical and horizontal digital video system to record lecture/demonstration, teacher remote control for all technology.

Collaborative Learning

The process of working as a member of a group wherein each member contributes information to allow the group to attain knowledge of the whole. A method, very much in vogue, where the teacher acts as a guide and resource to assist students in staying "on task." Often a product oriented method which encourages students to discover and integrate related knowledge through their own work and interests.

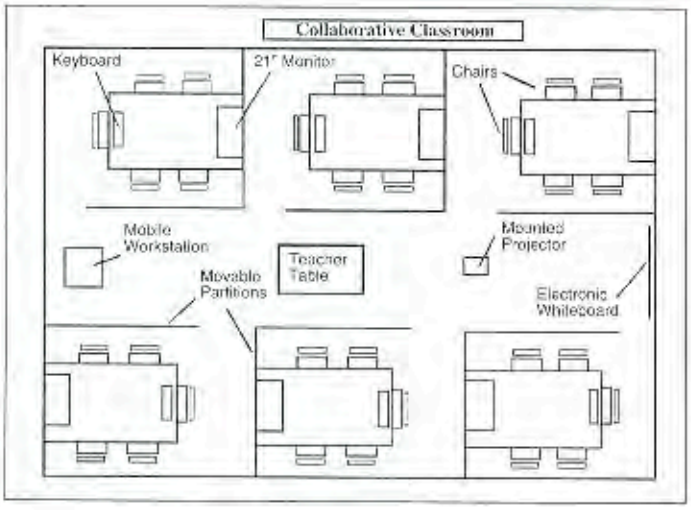
Design—Rectangular room, moveable partitions to divide into cubicles for five students, each cubicle outfitted with table for group work, teacher located at work table in the center of the room.

Furniture—Large tables and comfortable chairs.

Technology—Each cubicle has a multimedia computer with 21" monitor, teachers station mounted on moveable cart to allow relocation at any cubicle, electronic whiteboard, screen, suspended multimedia projector/sound system, teacher capable of viewing and controlling all workstations, teacher remote control of projection system.

Independent Study

A synonym for individual learning with guidance from a teacher. While not truly independent, the student works alone to master a body of knowledge on a particular subject or topic.



The teacher participates similarly as in collaborative learning, acting to direct the student's research and study and provide feedback to formulate and test ideas and conclusions. Usually a method for advanced students to allow a wider range of exposure to topics and ideas associated with the main subject of the study.

Design—8 × 8 cubicle with 6' sound absorbing partitions.

Furniture—Desk space on three sides, additional chair.

Technology—Full multimedia computer with speaker phone built-in, 21" monitor for layout and publishing.

Self Study

The attainment of knowledge through self directed study or experience in a subject area without formal guidance. Adult and continuing education has often recognized this instructional method by giving students credit for "life experience." Many people are life long learners whether they realize it or not. Their accumulated experiences, reading, study and personal and work relationships provide a vast amount of knowledge which allows them to respond and be successful in their work and personal lives. The world wide access to resources, discussions and interactions, made possible by technology will serve to focus more importance on the self study instructional method. Administrators can't design a room for self study. Learning takes place anywhere and everywhere, with and without technology access.

Change

When we think in terms of an instructional methods/ classroom design/technology systems integration, there are changes that must take place in our thinking. The first is "creative leadership." Next, that instructional methods can and should affect classroom design. And last, "creative scheduling."

Creative Leadership

This is probably the most important change. School districts must begin to think in new ways. Student learning must become the first priority. Leadership that stays with the "tried and true" will fail to take advantage of technology, technology/curriculum integration, and varied instructional methods. Maximizing all three areas gives teachers the tools to take advantage of different learning styles and optimizing the district curriculum for students. Creative leadership will play the major role in providing students new and exciting learning environments.

Instructional Methods Affect Classroom Design

We can no longer afford to take a one size fits all approach to classroom design. Teachers would like to have their classrooms fit the instructional method. Experience shows

us that. It has long been recognized that some subjects benefit from a specialized classroom (i.e. music, art, science, etc.). It is time to realize that core subjects (math, English, history, etc.) can benefit in the same way. While specialized equipment is not necessary to teach these subjects, optimizing the instructional methods for teaching can have a major impact on student learning. We see some of this thinking at the university level, less at the secondary, and almost none in elementary schools. That does not mean however, that we shouldn't consider the idea for elementary students. When we consider the expense of integrating the information and communications provided by technology with our curriculum, we must plan to obtain every benefit possible for students. Team teaching, for example, where team members are strong in different instructional methods, could be maximized for the team's strengths with specifically designed classrooms.

Creative Schedules

This is what's next. The "cookie cutter" classroom makes administrators live's easier—it doesn't matter what classroom you use. When classrooms are different, and various parts of the curriculum are taught using different instructional methods, we'll have to look at a much different type of class scheduling. If you want a real challenge, try to devise a class schedule that takes advantage of specialty classrooms with specifically integrated technologies for optimizing instructional methods. This can be your next paper.

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Multimedia is one of the more powerful strategies for technology in the classrooms of tomorrow. This article focuses on the potential of multimedia to alter learning environments in public schools. This author presents a field tested model and six step plan for using multimedia in the classroom.

Multimedia's Potential in 21st Century Learning

Kay Schultz

Multimedia is an expanding, powerful technology that provides learner control over a vast array of resources. Multimedia encyclopedias, databases, and instructional course ware provide classrooms instant access to available sounds, imagery, and text to make concepts come alive. Learning can be made more vibrant, collaborative, exciting, and memorable through teacher-produced student-produced multimedia projects.

Research has proven that learners who *see, hear, and interact* with content area material not only remember what they learn, but also understand it (Ward, 1994). Students whose learning styles do not respond to the traditional teaching styles can be stimulated and motivated to learn through the use of multimedia.

Technology Integration

Technology integration into our society is escalating at a rapid pace. While technology can be seen in homes, area businesses, shopping malls, and banks, it is missing in many classrooms across our nation. Schools apply today's technology in varying degrees. Making technology available to all learners has become an essential part of providing appropriate public education to all Americans.

What is a successful education for students in today's classrooms? This question is the real challenge for educators of today—to determine what students need to be taught now, that will make them productive, successful citizens in a changing world. The problem lies in the fact that while the world is changing from an industrial-age society to an information-age society (Naisbitt & Aburdene, 1990; St. Onge, 1993), schools lack any visible change (Bell & Elmquist, 1991; Cardell, 1993; Perelman, 1990) Little or no use of technology seems to be the norm. Students today need technology training to be able to function in the world of the future (Bell & Elmquist, 1991; Bruder, 1990; Dwyer, 1994; Mecklenberger, 1990; Pearlman, 1991; Perelman, 1990; Sheingold, 1991).

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Technology use shows great promise in serving as the catalyst for change in America's educational system (Bell & Elmquist, 1991). Preparing students for the future world of work will include the use of technology. Utilizing multimedia in the classroom is one way to help students become motivated to learn and become independent lifelong learners (D'Ignazio, 1994; Dwyer, 1994).

Multimedia Benefits Students and Teachers

Multimedia is defined as the integration of visual, graphic, audio, and textual information through the control of a computer. Multimedia is a powerful tool that allows the user (teachers or students) to track through vast amounts of varying types of information (Bruder, 1991; Burroughs, 1990; D'Ignazio, 1990; McCarthy, 1989). Technology's power is in the user's being able to view information in a non-linear fashion. The computer can be used to access a videodisc that plays a motion video image and retrieves auditory, graphic, and text information from a database, dictionary, or encyclopedia.

Using multimedia in the classroom, teachers create exciting and effective learning environments where students become actively involved in their own learning process. Multimedia provides new opportunities for students with varying learning styles. Multimedia is an ideal multisensory presentation platform, employing motion video, still images, audio of various types, text, and graphics that benefit many students.

Learning becomes an active process where students use the technologies to communicate their understanding. Students' use of multimedia presentations is one way to stimulate self expression. Teachers have found that multimedia projects are a good way to motivate students because when students become involved in multimedia, they become excited and self-motivated (Mageau, 1994).

Multimedia can be accomplished on various levels of sophistication depending on the equipment that is available. This means that multimedia can be as simple as students preparing a video book report by using a cable connector and a computer linked to a VCR, with a tape recorder providing sound by being plugged into the audio jack. Creative teachers and students can experiment with various technologies using different components to advance to a higher level of sophistication. Teachers can begin to integrate video cameras, digitizers, and graphics to create student video presentations. In advanced multimedia, students can utilize multimedia data bases to collect and sort images, special effects, sounds, narration, and use the computer to organize, store, and present information.

When teachers use multimedia, they have noticed students spending more time on learning tasks with fewer discipline problems, because they are actively engaged in the learning process (Ambron & Hooper, 1990). Characteristics of using multimedia in the learning process include: a new potential for motivating students, an ideal forum for cooperative learning; a multimodal avenue to learning; the ability to break information down into bite-size chunks; a match to associative, non-linear thinking processes; active participation of the user by user control of the computer's path; the potential of familiar media types to keep students focused on a task; the platform for students to be expressive in forms other than written text; and the relative ease in orienting students to the functions of multimedia software (Ambron & Hooper, 1990; McDermott & Combs, 1991).

Teachers with limited funds need to look around or scavenge (D'Ignazio, 1990) to see what equipment is already available in the school. Most schools possess tape recorders, VCR's cameras or camcorders, which provide a beginning for using multimedia. After finding whatever equipment that is available, pull the available pieces around your computer. Experiment with connections to see what can be possible with the connected equipment. Start small, think big.

Multimedia can be used in every subject area. Students can create and illustrate story problems in math using the computer, and then linking the computer to a VCR, overhead, or TV, so the whole class can participate in the solutions of the story problems. History and science reports can be made into multimedia presentations which makes excellent group projects. Curriculum areas can be integrated to include the language arts with the science and/or the history. The possibilities are limitless.

Multimedia emphasizes teaching across the curriculum making connections from smaller topics to larger topics. A benefit of using multimedia is the opportunity to have children working and learning together. Multimedia makes it possible to teach children to interact with one another, which can be one tool in preparing students for the world of work.

Multimedia as a Learning Tool.

An instructional application that combines a wide range of media (sound, video, images, text) to convey content to the student is only as good as the way it is used. When used simply as presentation devices for transmitting massive amounts of data, multimedia technologies add to the "information overload" already experienced by many teachers and learners. But when these technologies are applied instead as tools for structured inquiry based on higher-order thinking, users actively create their own mental models (Kozma & Croninger, 1992).

There are two main uses of multimedia in the classroom: as an instructional or lecture tool for the faculty member, and as a learning tool for student use. The latter is the ultimate use for multimedia. Multimedia is a challenge and can be an opportunity to experiment with new classroom teaching and organizational methods that increases students' productivity and encourages active learning. With the use of new teaching methods, the classroom can move from a teacher-centered approach to a student-centered approach.

Technology enables teachers to create materials by combining visual, textual, and auditory information into multimedia instructional lessons. The role of the teacher becomes that of a facilitator of learning rather than a deliverer of information.

The ultimate use of multimedia for enhancing learning is in the hands of the students. Technology-based activities provide opportunities for experiences using higher-order processes across several traditional disciplines through development of projects based on a core theme. Recognizing the interaction among restructured learning experiences, curriculum, and teachers, technology's impact on the end product of that interaction will be changed learning experiences for students.

Planning for Multimedia

Howles and Pettengill (1993) presented a seven-step approach to designing an instructional multimedia lesson. This seven-step approach can be used by the teacher in designing teacher-directed lessons using multimedia, or it can be used by the student in planning a student-centered multimedia project. The seven steps are:

STEP 1: Select potential lessons for multimedia enhancement
STEP 2: Describe specific learning outcomes for a lesson
STEP 3: Create an outline for the sequence of the content
STEP 4: Identify and list specific materials to be used
STEP 5: Explore multimedia techniques for presenting content
STEP 6: Develop a storyboard for the multimedia lesson
STEP 7: Produce the lesson using multimedia authoring software

The creation of a multimedia presentation takes planning with careful attention to scripting, theme development, sequencing, and visual design.

Step 1 is to choose a lesson that can be enhanced by the use of multimedia. The greatest advantage of using multimedia for delivering classroom presentations lies in its capability to add visual impact to a presenter's verbal commentary.

Step 2 asks the developer to write specific learner outcomes. What do you expect the learner to be able to exhibit following this presentation?

Step 3 is to create a written outline for the sequence of the content of the lesson.

Step 4 is to specify and list all materials to be used in the lesson. The library media specialist could help in gathering all available materials needed on a specific topic.

Step 5 is to explore multimedia techniques for presenting content. The multimedia presentation should enhance learning.

Step 6 is to design a storyboard for the multimedia presentation. This storyboard would be similar to a blueprint in showing how the lesson will develop through the use of multimedia.

Step 7 is the actual production of the lesson—putting it all together to make the multimedia product that will enhance teaching and learning.

The production of the multimedia lesson takes time and planning. Multimedia is a method that should be used occasionally when adding visual elements such as motion video, graphics, and colorful text and diagrams that would enhance the learning of the concept to be taught. These seven steps should first be mastered by the instructor when preparing multimedia presentations to the class. After the teacher masters the process, then students should be taught the seven steps so they can learn how to make multimedia presentations to the class when reporting on material that has been researched.

Model for Learning to Use Multimedia

Learning to work together as a team is becoming more and more important in the work force. The Secretary's Commission on Achieving Necessary Skills (SCANS) report lists as one of the competencies needed for solid job performance to read as follows: "They can work on teams, teach others, serve customers, lead negotiate, and work well with people from culturally diverse backgrounds." Since the focus is being placed on teamwork, a good model for using multimedia would be a team approach. The multimedia team can become a cadre working together to implement the use of multimedia in the classroom. The model looks like this:

TEAM

Computer Facilitator
Video Camcorder Facilitator
VCR Facilitator
Music Sound Audio Facilitator
Software Facilitator

The team consists of five members. Each member of the team will become the facilitator for that particular piece of equipment and will serve as the trainer to train the other four members of the team in the use of that particular piece of equipment. When all five members of the team become familiar with each piece of equipment, this team can serve as an advocate for using multimedia for teaching and learning.

STEP 1: Each person on a team of five should work with and become very familiar with a specific piece of equipment that is used for multimedia presentations and productions. This may take outside training or enough time to really work with a specific piece of equipment to see the capabilities in a multimedia presentation. The school administrator may be one of the experts on one of the areas of multimedia and should be involved in the process to offer support. Allow adequate time for this process.

STEP 2: The facilitator can then train the other four members on their specific equipment until all are fairly comfortable and knowledgeable about the function of each piece of equipment. The other four people do not need to be expert in the

use of all of the equipment, but should be able to have a working knowledge of the functions of the other four pieces of equipment.

STEP 3: Provide time for the five-member team to get together to build trust and rapport as a group, to solve problems, and to make decisions about how multimedia can enhance teaching and learning. Allow them to exchange ideas, communicate openly, and really listen to one another. Through brainstorming, prioritizing, and consensus building, this group can generate many useful ideas in how teachers and students can use multimedia to enhance teaching and learning.

STEP 4: Begin experimenting with how the equipment can be connected and manipulated by the computer. Team members need to become risk-takers and inventors. Try out all pieces of the equipment to see how they can be used together to get audio, visual, and graphics.

STEP 5: Work together with the software programs that are available. *VCR Companion* or *Hyperstudio* would be good beginning programs to work with. There are other programs available that will work with the multimedia equipment in merging text with pictures.

STEP 6: Experiment with the developing and producing of a simple multimedia project about the school, community, or other topic of interest to the area that could be presented to the entire staff during the fall staff development meetings. Let the multimedia team explain the process in getting this presentation together and suggest the availability of the team members to help others learn about multimedia.

STEP 7: Continue to meet together as a team of five during the school year for the purpose of offering support, sharing ideas, helping one another with classroom uses of multimedia and evangelizing the results to the rest of the faculty.

The goal of team building in a school community is to produce a sense of camaraderie so that those who work in the same building will be prepared to cooperate in new ways in the pursuit of common goals that will lead to better education for children (Maeroff, 1993). The promotion of the use of multimedia in the classroom for enhancing teaching and learning is the goal, and the multimedia team, through cooperation and continued encouragement and support from school leaders, serves as the catalyst to make this goal become a reality.

Multimedia is a method that can enhance the teaching and learning process through the use of cooperative learning, presentations, thinking, and problem solving. With multimedia, learning becomes an active process with the students doing the work and needing only to be guided by the instructor.

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Information technology presents schools with many unresolved ethical issues. The problems must be squarely met by school leaders and resolved at the earliest possible moments. Failing to address these issues in technology planning is failing to lead schools into the a new era of high technology learning and responsibility.

Ethical Issues of Educational Information Technologies[1]

Tweed W. Ross

New technologies present new problems to schools. The advent of modern communication and computer-driver technologies have provided a plethora of problems for school administrators. Not the least of these have been concerns about their ethical use by faculty and students. Many concerns have developed because of a lack of established policies and procedures. Past technologies used in schools have long traditions of appropriate guidelines. These guidelines have been formulated into Board Policy, law, and administrative regulation. Because computer and communication technologies are recent arrivals in the school curriculum, there exists a policy vacuum educators are struggling to fill.

These new technologies pose unforeseen ethical challenges which schools often try to fill with laws and procedures associated with older technologies. Consider the following scenarios and how they are related to technology from an different era.

The carbon-copy syndrome.
School documents call for an "original copy" to be submitted for authentication. With laser printing, which uses the same technology as copy machines, there is no way determine the "original copy." In fact, the original copy may only exist in an electronic format on a computer.

Theft of intellectual property.
A student or teacher copies a piece of software without permission from the publisher or author. However, the software is not diminished, it is still functional, the owner has its use and the publisher may have suffered no loss because it would never have been purchased.

Both scenarios raise concerns unknown before new technologies became widely available to schools. Subsequent issues about ethics and equity "tumble out" of basic questioning on how technology should be used to educate children.

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If schools are to effectively respond to the unforeseen ethical challenges posed by information technologies, they must open meaningful, responsible, dispassionate discussions with all reasonable audiences. These audiences include parents, administration, mature students, and the general public. To delay this discussion is to be reactive rather than proactive. To delay is to allow events to drive the agenda of implementing new technologies. The ethical vacuum created by new information technologies has presented schools with a problem, but not yet a crises. To put off addressing the issues presented by information technologies insures a later crisis.

The discussion of ethical uses of information technology in schools has two principal thrusts: policy development and a behavioral adjustment. Currently, there are five overlapping issues confronting school officials examining the ethical implications of information technologies: *copyright, privacy, accessibility, equity and humanity.*

Copyright

Issue

The issue of illegal or unauthorized duplication of electronic materials is not nearly as clear-cut as the Software Protection Association would like schools administrators to believe (Software Protection Association, 1991). The basic Copyright Law of the United State is constantly being reinterpreted in court challenges (17 U.S.C. & Lotus Development Corporation v. Paperback Software). If the doctrine of "fair-use" and archival backups didn't provide enough loop holes, the ease with which unauthorized copies can be produced and distributed makes copyright enforcement difficult. Many schools, whose policies prohibit software duplication, avoid confronting the issue of copyright by failing to implement effective policing campaigns. Such campaigns, would involve many dollars and a great deal negative publicity. Further, little has been shown to prove that software publishers would financially gain if unauthorized copying was stopped. Schools might avoid buying expensive software as they focused scarce resources on other priorities.

However, the issues of copyright are not simple for school personnel. How do students understand copying is wrong if the school copies software because its easy or they lack the money to buy quality products? Below are two likely scenarios.

Budget cutting
In an elementary school where the budget for instructional supplies has been drastically cut, teachers are concerned that there is not enough money to purchase quality software to use with their students. A number of teachers make illegal copies of commercial, education software, which they distribute to their colleagues (U.S. Department of Justice, 1992, p. 1).

Student games
A student shares an entertaining game received as a birthday present with classmates on the school equipment. This teacher finds this game to be not only entertaining but educational. Since the school had nothing to do with its purchase or installation, the teacher decides to leave the game on the machine.

Solution:

Policy. Schools must develop effective policies concerning the installation and duplication of software on school-owned equipment. These policies must be developed simultaneously with procedural statements for enforcement. If school boards and administrators are determined to limit the copying of software to the strict guidelines espoused by the Software Protection Association, they must accompany these policies with enforcement that will be a deterrence to those who would consider breaching such policies. To continue with threats such as the following with no meaningful enforcement serves little useful purpose.

COPYRIGHT INFRINGEMENT INVOLVING THE REPRODUCTION OR DISTRIBUTION OF AT LEAST 10 COPIES OF ONE OR MORE COPYRIGHTED WORK(S) WITH A RETAIL VALUE IN EXCESS OF $2500 (ANY KIND, NOT JUST COMPUTER SOFTWARE) WITHIN A 180 DAY PERIOD IS A FELONY. FIRST OFFENSE IS PUNISHABLE IN GENERAL BY A SENTENCE OF UP TO 5 YEARS AND/OR A FINE OF UP TO $250,000 FOR INDIVIDUALS AND $500,000 FOR ORGANIZATIONS.

(National School Boards Association, 1995, p. 11)

More effective policy choices involve random, regular checks of individual machines for unauthorized software and denial of services for those for regularly violate board policy. Such a policy, contains two hidden assumptions. First, the school is willing to make a commitment of resources towards enforcement. Second, information technologies have become such a vital part of the school program that denial of services is a real deterrent.

Behavior. Policies and punishments have negative impacts on the faculty and students attempting technology integration in schools. More effective in altering behavior are well reasoned educational campaigns and a commitment to providing needed resources for technology. A well-planned staff development program, coupled with a well-planned software purchasing budget will do much to alter behavior.

Privacy

Issue:

How much privacy do students or faculty members expect in electronic communication? Privacy in communication has been an issue since the invention of writing. New electronic means of communicating have heightened the ability to monitor and track personal communications in ways never considered by the most Machiavellian of administrators (Whalan, 1995). Questions about the appropriate degree of privacy arise from greatly expanded communication capability and networks (Johnson & Nissenbaum, 1995). Consider the following two scenarios:

Hate journal.

Students have journal writing assignments, which, because of the modern technologies are kept on a private, password-protected portion of a network. One student acquires another's password, reads the journal and finds it filled with "hate" statements, which he then publishes in the school paper.

Who is at fault? What should be done?

The underage student.

A faculty member is rumored to be having an affair with an underage student. The network administrator notices there is an inordinate number of messages between the faculty member and student.

Should the network administrator read the messages?

Should the network administrator tell supervisors?

The issues of privacy associated with information technologies in the schools must be balanced with basic concerns for individuals and society. There will be many opportunities and challenges—all for the best of reasons—to use the new technologies to examine and investigate students and faculty. However, clear guidelines should be established at the outset. These guidelines should only be violated after careful deliberation.

Solution:

Policy. After study, with a wide variety district sources, including students, faculty, legal counsel, and the public, school administrators should prepare for Board adoption a carefully crafted policy document. This document should outline the rights to privacy that employees and students can expect when using the district's technology. This policy should be carefully crafted and well articulated to all parties involved. It should only be breached following the direction of a competent legal jurisdiction and never to benefit either side of a disagreement. Using the previous *underage student* scenario about a student and faculty member relationship; if Board policy established absolute rights to privacy neither the Board, nor the teacher would be entitled to expose the student's communication.

Behavior. As part of the training received to gain access to the district technology resources, including networks and e-mail, a thorough ethical discussion with staff and students should be initiated. This discussion should involve explanation of District's policies and the reasoning used to develop these policies. It seems role playing exercises would be an important aspect of these efforts. Students and staff members should be presented with scenarios for their reaction. The scenario sessions would also provide a practical forum for examination of district policies.

Accessibility

Issue

Schools have, by tradition or policy, closely regulated access to students and student access to outside groups. Old patterns of regulation are visible in library review committees and placards requesting visitors to check in at the office when entering buildings. Security and the desire of particular social groups to gain access to students have increased school problems regarding student access.

The mantra of the Information Age is for scholars of all ages to be able to "learning anything, anywhere, anytime." This unchallenged assumption brings with it new connotations as the schools fling open electronic doors to the Internet. Should students learn about drugs, bombs, pornography, hate, violence, tobacco, and alcohol via electronic browsers? "Until now, most kids were confronted with real controversies only in carefully managed classroom situations. But on the Net, students are likely to encounter multiple responses—some of them offensive and inimical to consensus." (Tally & Brunner, 1995, p. 14).

Technology presents issues which must be addressed from ethical viewpoints about allowing student access to the outside world and outside world access to students. New communication technology, such as Internet access, has flung open schools' electronic doors.

The student searcher.

Students in a junior high social science class are introduced to Internet searching using Netscape®. One student stumbles upon the materials needed for a thermite reaction. After burning down the family garage, this student explains that he learned to mix this concoction at school.

The unwanted agenda.

A distant group sets out on an educational agenda highly controversial and contrary to local norms. Several students join the "chat group" maintained by this controversial organization on the Internet. Some students choose to adhere to this outside group's practices.

Solution

Policy. Policy developments for safe accessibility need to be simultaneously addressed at several levels by school administrators and Boards. The following issues should be well thought out and articulated prior to implementation of Internet accessibility.

1. How many machines in each building will have access to the Internet: one machine in a central location? all the machines in one lab? all the machines throughout the building? The more machines that can link to the Internet the greater the opportunity for student

empowerment and learning. The more machines that can link to the Internet, the greater the potential for unwanted activities to take place.

2. What kinds of software control will be in place to limit student access and who will implement these software controls. Several commercial software packages are available to regulate student access to materials on the Internet. Some are SurfWatch®, Net Nanny®, CYBERsitter®, and Webtrack®. Each of these in some way or another prevents access to certain types of files on the Internet. The question is who determines what types of files are unacceptable for students.
3. A policy clearly defining the expectations of the administration and school board concerning the use of school access to the Internet should be established and communicated to all faculty and students. This policy should establish standards of educational use and penalties for misuse.

Behavior. Schools have for sometime, as a safety issue, helped students understand there are some people or groups to avoid. These efforts need to be expanded to include communication via the Internet. Schools teach even the smallest children not to talk to strangers. It is similar via the Internet. Responsible "net surfing" behaviors must be encouraged and taught. Students find ways to avoid policies and software that limit access just as they have learned how to get on the city bus to go downtown to "X-rated movies;" even though the school bus never went there (Executive Educator, 1995).

Equity

Issue

In coming years, the quality of educational opportunity may be as well defined by equitable technological resources as it is defined today by library resources, class size, instructional effectiveness, textbooks and administrative support. If America's future relies on a technologically literate populace, all groups must equally share in the resources which will enlarge student opportunities to learn. Failing to provide equitable access to new learning technologies is to create a new set of haves and have-nots. Yet this seems to be the very thing many schools are doing. A number of influential demographers point out that America seems to be developing a wider division between affluent and economically disadvantaged (Hodgkinson, 1991; United Way, 1989). Unless schools, in implementing technology, provide for equitable student access they exacerbate the problem. Consider the following scenarios.

The affluent student.

A student comes from a very affluent family which has several computers in the home all connected to high-speed modems and on-line services. These computers contain modern word processors, graphical calculators and other CD's for data storage. Laser printing is available in the home.

The non-affluent student.

Another student comes from a very disadvantaged family seeking only to provide the basic necessities of food and shelter. It is often a struggle to find sufficient money to purchase pencils, paper and other school supplies.

Both students are assigned a research paper as a homework assignment.

The affluent school.

Two schools operate in the same district. The Board has decided to provide each school an identical amount of money on a per pupil bases for technology implementation. These are neighborhood schools and one school is in an affluent part of the district, the other is in the run down part of the school district. The parents organization for the affluent school offers to have a fund raiser to support technology in their children's school.

Problems of gender-equity and access to technology have been well examined and many schools are actively pursuing solutions (Sanders & Stone, 1986). Problems associated with economic access and equity seem to be just surfacing. No one would seriously consider allowing only those students who could afford textbooks to have them. If technology is considered analogous to textbooks, who would propose that educational technology be limited to those who can afford to purchase their own?

Solution

Policy. School administrators and boards may need to attack the issue of accessibility on a number of fronts.

1. Schools should establish technology implementation as a high priority in all their buildings.
2. Schools should provide on-going budget commitments to district facilities. These commitments should be based on need, not equal dollars.
3. Schools should establish opportunities for those students who have few resources at home to use school equipment. This may include opening technology classrooms before and after school and on weekends.

Behavior. School administrators and teachers must practice and demonstrate behaviors that support equitable access to the necessary technology for students to learn. It goes without saying that blatant discrimination on the account of gender or race cannot be tolerated. Subtle discriminations on any account need to be avoided. These behaviors must insure that all students, irrespective of background, have an equal opportunity to the tools of learning. Technological access cannot be promoted or denied to any class of students. Careful attention to classroom behaviors must be paid to insure that such inequities are avoided.

Humanity

Issue

It is not a new phenomenon that schools are torn between delivering content and developing socialized individuals ready to take a place in the modern American community. Educational technology advocates propose that new electronic devices offer opportunities to impart content in "more, better, faster, cheaper" ways (Perelman, 1992). However, as Neil Postman (1995) explained new technologies of the past have been Faustian bargains. Unless schools pay particular care, information technologies have the potential to deprive students of the humane treatment and socialization that hallmark American educational efforts.

Home schooling.

Two highly technically literate parents opt to keep their children at home and purchase quality software products for the instruction of their children. Additionally, these children have access to MODEMS and on-line data services. They become proficient in using these technologies to acquire basic knowledge in traditional content. However, they never attend a school with other children, and withdraw from social exchanges with peers.

ILSs at ttheir best.

A local school is hard pressed by the public at large and the media to raise the scores of their students on standardized tests. To accomplish this task the set up a comprehensive Integrated Learning System. For major portions of the school day, students work on assignments at computer terminals with only minimal contact with teachers and other students.

Solution

Policy. School leaders must set about establishing policies that focus on the real agenda of the public school. Technology has presented opportunities to enhance the education of students, but this should not be used to supplant socialization of students. This policy must not be an either high academic achievement with technology or effective socialization without technology. Policies must be developed which promote using educational technologies in the school to enhance the academic accomplishments of students while liberating instructional personnel so they can focus on helping students prepare for those socialization skills identified by the SCANS report. (1991)

Behavior. Technologies provide a number of new opportunities for students to pursue socialization skills. New educational technologies can enhance collaborative and cooperative efforts. One of the real benefits of new electronic networks are ways for students to collaboratively work on projects. "Working together, apart" (Schrage, 1990) becomes a real possibility with the development of local and wide area networks. Teachers can use technologies to promote understanding with a wide variety of students locally and internationally.

Summary

In order to insure the safety of students and the effective implementation of educational information technologies, school administrators, teachers, Boards of Education and other stockholders must come together to develop effective, locally-acceptable, solutions to ethical dilemmas present by new technologies. The problems brought about by copyright, privacy, accessibility, equity and humanity issues can only be resolved by thoughtful deliberation which stressing two factors: educational preparation and student safety for the 21st century.

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Footnotes

1. For the purposes of this article, "Information Technologies" are defined as those electronic technologies that enhance the management of data or communication. Schools face a wide variety of ethical dilemmas posed by other technologies—biomedical for example—but this article avoids these issues.