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Implementing Educational Technology in K-12 Public Education: The Importance of Factors to Senior School Administrators in Pennsylvania

Lawrence A, Tomei, EdDRobert Morris University, Moon Township, PA

David Carbonara, EdDDuquesne University, Pittsburgh PA

INTRODUCTION

Use of Technology. The word "technology" has taken on several connotations during its relatively recent arrival in the middle of the 20th century. Technology has always been described from the perspective of hardware; specifically, devices that deliver information and serve as tools to facilitate a task and solve problems. From its initial ancestry, the definition of technology expanded in concert with the phenomenal increases in applications and further refinement to our collective understanding of how technology impacts teaching and learning.

Technology and the Reality of Education. Between 1998 and 1999, the number of computers in the US schools increased 13 percent, and almost 80 percent of schools have Internet connections (Shelly, 2000). However, schools are experiencing difficulty in effectively integrating these technologies into existing curricula (Brand, 1998).

The commitment to technology is incumbent upon all levels of all stakeholders involved in education. Administrators, teachers and parents, even the local community, must work together if learning is to benefit from technology. Yet, we all know from experience that it can very difficult to focus on integrating technology to support learning without overcoming basic technological equipment and facilities issues. Schools that serve students in economically disadvantaged areas typically have greater challenges than schools in more affluent communities. For some, buildings are so old that providing the necessary infrastructure is very difficult. For others, a lack of security is a problem manifested by outfitting computer classrooms with iron bars on outside windows. Schools in particular communities have severe access issues in part because of problems with basic electric service; many schools are simply unable to handle the additional load required by computer networks without major (expensive) modifications. Studies have found technology to be effective if it is embedded in other school improvement efforts (McNabb, 1999; Byrom, 1998; Goldman et al, 1999; and, Wilson & Peterson, 1995).

Technology as a Teaching and Learning Strategy. Research investigations have also determined that technology contributes to raising student learning outcomes in two primary ways: (a) through active, meaningful learning and challenging collaboration, and (b) via real-life tasks involving technology as a tool for learning, communication, and collaboration (Jones et al, 1995).

School boards are willing to spend money on preparing schools to be technology compliant, however, in today's outcomes-based atmosphere, board members (and their constituents) expect tangible results. Research confirms that more computers, more hardware, software, and increasing the number of computer peripherals without giving teachers training hardly ever impact students. Many school districts have computers, laser disks, digital cameras, scanner and other technology equipment that are only used by a very small percent of the faculty. "One of the biggest barriers to effective use of technology in education is the lack of professional development" (Norman, 2000).

The Business of Technology. Many educators are convinced that once computers are installed and teachers trained, results are instantaneous (Crouch, 1999). Even with the best equipment, training, and intentions, this common misunderstanding concerning how long it takes technology to become a part of the school often creates disconnects among the many constituents of instructional technology. The business of using technology effectively in schools is more accurately reflected as a step-by-step process that takes considerable time and effort before manifesting itself. Involved in this intentional process are people, funding, and resources.

Students, teachers, administrators, curriculum designers, technology coordinators, financial managers, and parents are only a few of the "people" with a vested interest in the business of technology. (Tomei, 2002).

Likewise, the capital costs of hardware and software represent only the shell of technology funding that also embraces training, maintenance, and support and has propagated itself into the multi-billion dollar educational technology industry in the United States alone (Testimony to the US Congress, 1995).

A close examination of any school's comprehensive technology plan turns up a plethora of assets involved in a successful technology program. From facility planning to training programs to risk management and purchasing policies, technology is often defined in terms of its impact on resources.

Some school leaders use computer technology in their personal, professional practice and thus believe that others should use it also. They may find that the use of technology creates a vehicle to share information, and a facility to collaborate. The technology skill may have a direct impact on their belief of the efficacy of computer use. This belief may affect their decision on how well technology is integrated into the classroom. "One cannot have a disposition without an associated skill" (Raths, 2001). In his article, James Raths discusses the relationship between dispositions and skills. He discusses beliefs as pre-dispositions.

However, some school districts believe that they are 'doing' technology when in reality, they are not. They create this façade of computer use. The question then becomes one of trying to identify why the façade exists. What are the practices of school district leaders integrating technology? What are the beliefs of school district leaders about technology use in school districts?

REVIEW OF THE LITERATURE

Synopsis of the Literature Review: Four Key Studies

Texas A&M University Survey of State-wide Technology Integration. Prior to a comprehensive study conducted by *Texas A&M University* in 2000-01, the Texas State Legislature accelerated the integration of technology into public education with a substantial infusion of funding into technology education. These efforts resulted in a considerable technology infrastructure throughout the state's 812 districts. In an attempt to document, validate, and verify the robustness of their efforts, as well as isolate the key factors affecting successful technology integration into K-12 schools, Texas A&M University surveyed participating districts and posed the following questions (Texas A&M University, 2002):

1. What district policies affect technology resources and technology integration?
2. What is the district's present technology infrastructure?
3. What level of district support is provided to assure technology sustainability?
4. What level and kind of technology use occurs in the district?
5. What level and manners of professional development are provided by the district?
6. What technology outreach does the district provide to the community?

It was discovered that uninterrupted *technology funding* was the key concern for districts state-wide while *teacher training* ranked a close second.

National School Boards Association (NSBA) Challenge Survey. During October 2004, the NSBA conducted an e-mail survey consisting of ten questions sent to 2,000 technology specialists, teachers, administrators and school board members. Specifically, the survey asked respondents' opinions regarding:

1. What is the biggest challenge facing your school district in the area of technology?
2. Please rate your school's district's K-12 curriculum in preparing students for the 21st century knowledge society?
3. Are new teachers entering the classroom better prepared than in the past to effectively integrate technology into the classroom to improve academic learning?
4. Has the use of technology in the classroom increased educational opportunities for your students?
5. How has technology increased educational opportunities for students? Are they more engaged in learning; improved performance on tests; increased critical thinking skills; or stronger ability to communicate?
6. Is home access to the Internet a problem for low income students in the district?
   a. If so, what steps have been taken to fix the problem for low-income students?
7. How important has the federal E-rate program been in helping the school district set and meet technology goals?
8. Would an Federal Communications Commission's (FCC) decision to suspend new grants from the E-rate program impact your school district?
   a. Describe the impact in terms of dollars and programs.

More than 900 replies to the survey were received. Forty-six percent of respondents stated that *integrating technology into the classroom* is their major challenge while 47 percent identified *technology funding*. Six percent recognize closing the *digital divide* as their most challenging technology-related issue.

Critical Factors in the Effective Use of Technology. The study conducted at Walden University by Laura J. Dowling and Darci J. Harland in January 2001 further confirmed certain critical factors for technology integration in the K12 environment. The authors found: availability of computers as a result of variable *funding*, *teacher comfort level*, and *matching technological applications to particular subject areas* were among their chief concerns.

Factors Influencing Student Teachers' Use of Technology. Brent, Brawner, and Van Dyk (2003) compiled a series of recommendations for maximizing the effectiveness of instructional technology programs in a K-12 environment. Their findings included the advantages of experiences with technology-based methods classes integrated throughout the entire student teacher preparation program; identification of cooperating teachers who support and encourage the use of technology in their own classrooms; explicit guidance regarding available technology in schools where student teachers are placed; implied expectations that at least two lessons will be delivered using technology tools; and, a commitment from student teachers regarding the use of technology at varying levels of academic student achievement.

A recap of the critical factor found in these four studies is found in the left-most column of Table 1. The studies offered a review of the literature that produced an inventory of key factors appropriate for consideration by K-12 public school districts, classroom teachers, and higher education teacher preparation programs. However, these studies placed equal importance on each of the factors examined and did not attempt to isolate those most important to district decision-makers.

In 2003, the Technology Façade was introduced to serve as a guide for the assessment of instructional technology in K-12 schools. The 20-item checklist encompasses three critical elements: (1) the Use of Technology and its impact on teaching and learning in the classroom; (2) the Necessary Infrastructure that consists of people, financial investments, and resources; and, (3) the use of technology as a Viable Instructional Strategy for the classroom.

Since its inception in 1996, the Façade checklist has provided an authentic assessment instrument for hundreds of schools and school districts seeking to advance more effective technology programs. Some of the Façade's factors resemble closely those found in previous studies;

Table 1. Critical factors affecting the integration of technology in K-12 schools:A synopsis of findings of selected studies

Critical Factors (Selected Studies)	Twenty Factors (Technology Façade)
Technology funding ***Teacher training***	*1. **Technologies used by classroom teachers***
	2. Accessibility of computer facilities
Integrating technology *into the classroom* ***Technology funding*** ***Digital divide***	*3. Location of school computers*
	*4. Classroom teachers' **applications of technology***
	5. Computer teacher expected to have lesson plans
Funding ***Teacher comfort level*** *matching **technological applications** to particular subject areas*	*6. Status of classroom curriculum software*
	*7. Extent of **teacher technology training***
	8. Extent of teachers participation on the technology committee
Technology-based methods classes *Cooperating teachers who support and encourage the use of technology* *Guidance for student teachers regarding available technology* *Use of **technology tools for classroom teaching*** *Use of technology at **varying levels of academic student achievement***	*9. Extent of parents, community leaders, alumni, and students participation on the technology committee*
	10. Access to technology professionals
	*11. **Technology Funding/ Budgeting***
	12. Teacher recognition program for technology development/ use
	13. School technology plan
	14. Contents/ coverage of school technology plan
	15. Computers in school labs and classrooms
	16. "Scope And Sequence" of student technology competencies
	*17. Teacher use of technology at **varying levels of instruction***
	18. Learning objectives that include technology-based resources
	*19. Use of **technology resources** to present a lesson*
	*20. **Student experiences with computers** classroom/ laboratory*

others are unique to the publication. The right-most column of Table 1 depicts the 20 factors of the Façade and highlights (bold) common factors from the studies examined. With the possible exception of two characteristics found in the *Factors Influencing Student Teachers' Use of Technology* study (Brent, Brawner, & Van Dyk, 2003) pertaining to the preparation of student-teachers the Façade checklist contained all factors considered relevant to a school district decision-maker. However, none of the studies, including the Façade, offered a perspective regarding the importance of factors or the weight they should carry when making decisions. That became the purpose of this study.

Portions of the Teachers' Attitudes Toward Information Technology survey were used as a survey instrument to determine the professional disposition of the respondent to the use of technology. This survey originated at the Texas Center for Educational Technology. Teachers' attitudes toward computers is a Likert/Semantic Differential Instrument that measures attitudes on 7-20 subscales. It was developed by Rhonda Christensen and Gerald Knezek as part of the 1995-97 Matthews Chair for Research in Education project of the College of Education, University of North Texas (Knezek, 1997).

"One cannot have a disposition without an associated skill" (Raths, 2001). In this article, James Raths discusses the relationship between dispositions and skills. He discusses beliefs as pre-dispositions. However, in all cases, change can occur and thus dispositions can change. The question for this study revolves around the relationship between technology practice and dispositions. Do relationships exist between the practice of technology implementation in K-12 schools and the role of technology disposition of leaders in school districts.

PARTICIPANTS

There are 501 school districts in the Commonwealth of Pennsylvania. For the most part, districts are governed by nine-member boards of directors elected by their respective constituencies to a four-year term of office. In Pennsylvania, the legal qualifications for school board membership require candidates to be an adult citizen of the state and reside in the school district that s/he services. In addition to such bare legal requirements, those wishing to serve as a school board member should possess certain basic qualities, including: a high standard of personal integrity; a broad viewpoint to be able to represent impartially all the people of the community; good physical energy, sound mental health, and social poise above the average; a profound interest in the welfare of all the children in the community; and, a willingness to develop a sympathetic understanding of the teaching and learning process as it involves the human relationships between teachers and pupils. (PA School Board Association, 2004).

Beyond these minimal considerations, however, there are no requirements that board members possess a financial, technical, or educational background. While such responsibilities are implied in the administrative staff and professional staff of the district, board members are often asked to judge the acumen of very technical issues, not the least of which, include information and instructional technology.

THE STUDY

The research sought to include an investigation of all 501 school districts including as many of the superintendents and approximately 4500 school board members as possible. A link to the online Web-Surveyor © questionnaire was sent to all 501 school districts in the Commonwealth of Pennsylvania via email addresses provided by the Pennsylvania Department of Education. District were asked to provide the web address to each of their superintendents and elected school board directors linking them to a short survey instrument in which a rating factor of 1-5 (with "1" being least important to "5" as most important) was used to assess each of the twenty factors of the Technology Façade.

Data analysis began in November 2005 with conclusions and recommendations formed during December 2005. Analysis was completed and the required IRMA report provided to conference track on January 10, 2006. Initial results were presented for the first time at the IRMA 2006 International Conference.

FINDINGS

Responses were received from 125 of the 501 school districts (25%) polled. Although email addresses were found for all districts state-wide, 40 districts (8.0%) were returned as incorrect or non-existent accounts and were forwarded to PDE for their attention.

Of the responses received, the majority was completed by district superintendents (72.7%), followed by district administrators (17.4%), school board members (8.3%), and others (1.7%). As a result, the emphasis of this paper (which began as a look at factors critical to school board members) shifted to an examination of factors as they pertain more generally to senior school administrators as a whole.

Critical Factors Affecting the Integration of Technology in K-12 Schools. Based on the distribution of responses taken from Question 2 of the online survey, it was found that eight of the 20 factors (40%) were identified by respondents as "extremely important" and received a concurrence rating exceeding 60 percent. As such, they were selected to represent the most important factors for consideration in the integration of technology.

The results pertaining to critical factors of the questionnaire are depicted in Table 2. After plotting the responses indicating agreement that a particular factor was "extremely important," it was determined that seven of the 20 factors were identified as critical to school district administrators.

Factor 7, technology training for classroom teachers, outstripped the other items as the most significant factor for consideration, followed closely by Factor 3 which examined whether technologies are used by the teachers. The seven factors uncovered as critical decision-making criteria will hold in good stead any administrator seeking to promote an instructional technology program.

In addition, respondents were given the opportunity to identify any additional factors for consideration. These included: correlation with student achievement (and overall evidence of student performance), teacher technology certification process, elimination of paper communications, state funding infrastructure, and use of grants to acquire funding to facilitate technology implementation.

Critical Dispositions Affecting the Integration of Technology in K-12 Schools. Table 3 lists the descriptive statistics for the ten disposition questions. The Likert scale consisted of a range from one to five. The rank order of these ten place "I like to use technology in my daily activities" as the most agreed to statement, followed by "Technology increases communication between administrators". The least agreed to statement was "Technology relieves teachers of routine

Table 2. Descriptive statistics from critical factor questions

	Technologies used by classroom teachers	*Accessibility of computer facilities*	*Location of school computers*	*Classroom teachers' applications of technology*	*Computer teacher expected to have lesson plans*	*Status of classroom curriculum software*	*Extent of teacher technology training*	*Extent of teachers participation on the technology committee*	*Extent of participation on the technology committee*	*Access to technology professionals*
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Ratings	66.7	40.2	70.5	66.4	51.6	55.4	76.0	61.5	35.2	50.8
Min	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Max	498.0	235.0	522.0	492.0	384.0	408.0	558.0	456.0	234.0	372.0
Mean	116.0	95.5	115.17	114.83	107.0	110.67	116.33	112.17	98.67	108.50
Std Dev	199.15	110.20	206.99	196.18	150.33	167.64	221.34	180.40	104.17	154.46
	Technology Funding/ Budgeting	*Teacher recognition program*	*School technology plan*	*Contents/ coverage of school technology plan*	*Computers in school labs and classrooms*	*"Scope And Sequence" of student technology competencies*	*Teacher use of technology at varying levels of instruction*	*Learning objectives that include technology-based resources*	*Use of technology resources to present a lesson*	*Student experiences with computers classroom/ laboratory*
	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20
Ratings	59.0	36.1	63.1	66.4	43.3	45.5	40.5	40.0	45.9	47.9
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Max	438.0	185.0	468.0	492.0	318.0	336.0	288.0	246.0	294.0	348.0
Mean	111.0	93.67	113.17	113.67	105.67	107.50	104.5	100.5	107.33	107.5
Std Dev	173.34	87.69	185.68	194.09	139.89	148.46	129.61	116.99	141.31	155.07

Table 3. Descriptive statistics from disposition questions

	Technology helps me to organize my time	Technology increases my productivity	Technology solves more problems than it causes	Technology increases student learning	Technology increases communication between administrators	Technology is use by the administrators to solve problems	Technology relieves teachers of routine duties	Technology relieves administrators of routine duties	I like to use technology in my daily activities	I would be lost without the technology I use
	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Mean	4.47	4.59	4.08	4.28	4.64	4.30	3.93	3.95	4.65	4.24
S.E.M.	0.066	0.055	0.091	0.067	0.053	0.063	0.080	0.085	0.053	0.089
Var	0.530	0.376	1.010	0.550	0.346	0.491	0.783	0.883	0.346	0.969

tasks". Administrators believe that technology helps the communication role of administrators, but does not affect teachers in the same way.

All correlations were positive. This finding suggests that a non-inverse effect is in place. The disposition that possessed the most significant results was listed as, "Technology helps me to organize my time" followed by "Technology increases student learning". These results may be interpreted as one of a positive belief of the effects of technology on administrator's organization of their time and that technology can help children learn. These dispositions are linked to the importance of providing technology in the schools, to train the classroom teachers and that teacher participation are all related to supporting the use of technology to improve teaching and learning.

This study was not a path analytic study, so no conclusions about which came first (disposition or school leader's practice) can be made. The only inference we can make is that a positive correlation exists between dispositions, such as, *Technology helps me to organize my time* and school leadership items, such as, *Classroom teachers use technology for: grading, lesson preparation , out of class assignments.*

RECOMMENDATIONS FOR FURTHER STUDY

Regardless of the respondents who participated in this study, further study specifically of school board members is needed before a conclusive statement can be rendered regarding the most important factors and dispositions for this particular category of school administrator. As described earlier, the emphasis of this paper shifted to an examination of factors as they pertain more generally to senior school administrators. The majority of the respondents (72.7%) were district superintendents while only 8.3% were actual school board members; the original target for this study. While investigators believe that the results will not be significantly different and that the key factors important to district superintendents will also be those most critical to school board decision-makers, such claims cannot be made without further study which will be conducted as a follow-on to this paper.

Disposition concepts need to be further defined. More information about dispositions, in general, is needed. There also exists a need to more clearly define the concept and facets of technology dispositions. We know that dispositions can come from a belief structure and that consistent and repeated practice can influence the development of dispositions. Perhaps a path analysis study of the beta coefficients and a factor analysis will help.

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