The Preparation and Role of Technology Leadership for the Schools

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Introduction

The current educational technology revolution began in 1971 as one byproduct of an experiment by two undergraduates working in Cupertino, CA. Bill Fernandez and Steve Wozniak created the first personal computer in the Fernandez family garage and gave it the whimsical name, the "Cream Soda Computer." A year later Steve Jobs became the third member of the "second garage team" and the first Apple Computer was born. That computer went to market in 1976 (Malone, 2001) and the world has been a different place ever since.

A generation before this "garage revolution," American industry had been well invested in the new electronic computer technologies. Major American industries became the second group of purchasers for the early computer technology. They were following the lead provided by the country's military which funded the first experimental prototypes, and bought the first commercial systems.

The electronic computer era all began in 1946 when the Electrical Numerical Integrator And Calculator I (ENIAC) first drew down the lights of West Philadelphia with its 18,000 vacuum tubes and 160 mega watt power load. The University of Pennsylvania transferred this experimental project, created for the military, over to the Electronic Controls Corporation for marketing. The Electronic Controls Company named the first commercial computers as the Universal Automatic Computer (UNIVAC) (Shawcros, 2003).

A significant development with these first generation computers was the development of a new language, FORTRAN for "formula translator." This first modern computer language was released by IBM in 1957. Prior to this language, all computer tasks required that a computer scientist write an algorithm for the computer to follow to do each specific task. This computer language made it possible for virtually any well educated scientist, engineer or social science researcher to create solutions to complex mathematics and statistics problems.

In 1963 another language was published by two professors of mathematics and computer science from Dartmouth College, John Kemeny and Thomas Kurtz. They designed their new computer language to facilitate its use by students. This language, "Beginner's All-purpose Symbolic Instruction Code (BASIC)," arrived just ahead of the era of the desktop computer, and made the explosion in computer use possible.

Along with the 1960's came a new collegiate major, "computer science." Graduate programs were first established from the engineering divisions of well known technical universities which provided the personnel for both the corporate centers, as well as the undergraduate computer science programs. Industry took to the computer systems and invested heavily in each wave of technology. By the middle of the 1970's there were over 2,000,000 computers being used in the United States. Approximately 90% of these were used by the U.S. military and private corporations (Juliussen, n.d.).

The capabilities of these early computers improved each year, and the cost for purchasing one fell with each generation. Just 40 years ago the UNIVAC 1108 offered customers a 1.3 MHz CPU with a whopping half megabyte of RAM, and a full 100 megabyte hard drive. In 1968 all of this computing power cost only $1,600,000.00. With inflation, today that would equal about $9 million for the computing power of a new wristwatch. By the middle of the 1960's corporate consolidation of the computer manufacturing business led to the era of domination by Snow White (IBM) and the Seven

Dwarfs (AT&T, Burroughs, Univac, NCR, Control Data, RCA & Honeywell). In the 1970's corporate consolidation brought this group down to the BUNCH (Burroughs, Univac, NCR, Control Data, & Honeywell). Also by 1970, computer systems began to operate faster, more efficiently, and with less power by using germanium chips.

The impetus for research and development and the rapid change that occurred in computer science was provided by the federal government. The computer corporations used the experience they gained with the design and development of ever more complex military command and control systems in designing business systems for corporations. This symbiotic relationship provided American corporations with a significant advantage, and American industries were able to assume the international leadership position in a range of fields (Committee on Innovations in Computing and Communications, 1999).

However, American education was very slow to accept the new technologies. The first attempt to integrate computers into instruction was not very successful. During the 1960's and 1970's the Programmed Logic for Automatic Teaching Operations (PLATO), ran from the main-frame computer of the University of Illinois (ILIAC). That system failed as being too expensive to operate and to complex to use. There were only 1,000 ports that individual school computers could log onto at any moment (McNeil, 2004).

Indeed, it was not until the availability of stand-alone micro computers in the 1980's that school systems began to invest in the new technology. During that decade, school administrators vied with one another to have the newest, and largest "computer laboratories." These shiny rooms were frequently the only air-condition spaces in the public schools, and were the pride of both the school's administrators and the elected members of the local school boards. The down-side of this era of school computer laboratories was that the “labs” were only used a few hours each school day, and sat empty over 80% of the time.

One reason for this waste reflects the fact that most classroom teachers wanted to have nothing to do with the computers which were almost always relegated to a “computer teacher’s” responsibility. Children would have an hour of “computer class” once a week or so. As the “computer teacher” was responsible to instruct these classes, classroom teachers saw computer class as a time for them to catch up with paperwork.

The rules changed with the opening of access to the Internet. Today kindergarten aged children of the X-generation are coming to school tech savvy and computer literate. Teachers and schools are scrambling today to catch up to these children and the needs of this digital era. For the first, time open access computer locations now appear throughout the school buildings of most school districts. Today an increasing proportion of the school system budget is being spent in support of technology; and, the technology departments of schools are staffed with a growing team of both educators and technicians (Lesisko, 2004). Despite this growth, only a minority of state education departments has created licensing or certification credentials for instructional technology leaders. Pennsylvania is one of only 19 states to have such a professional certification program.

Adequate technical support is critical to the success of any application of educational technology. Effective use of educational technology by classroom teachers is dependant upon having educators confident in the knowledge that there is easy access to technical and instructional support (Ronnkvist, Dexter, & Anderson, 2000). In addition to the needs of teachers, administrators must also be provided with ongoing technical expertise and support. Without this support at both levels (faculty and administration), any effort to infuse technology into the curriculum and operations of the school are doomed to follow the other well-meaning educational innovations of yesterday to the junk-heap of history.

This need notwithstanding, Pereus (2001) demonstrated that few districts allocate enough resources for successful district wide technology support. One sign that the district is not providing adequate technology support is evident when “service requests” require several weeks to be answered. Pereus also noted that, “…delays of this length may create major problems in continuity and the use of technology in the classroom” (p. 5-37). These delays can destroy any continuity within the curriculum that is being taught with technological assistance. Pereus argued that the educational staff should lobby school boards and central administration for adequate support personnel to ensure rapid responses and accurate problem resolutions.

Fifteen years ago Arfman and Roden (1992) also reported that technical personnel must be available to plan, install and repair computing resources throughout a well equipped school district. They also made the point that also that school technology support staff must be both proactive and reactive in their operations. Proactive support services such as network administration, hardware, software troubleshooting, server maintenance, infrastructure monitoring, virus protection, hardware repairs and upgrades must be performed *de rigueur*, while still providing immediate responses to the service and maintenance needs expressed by the education community.

These roles and functions of the technology staff in school systems are very similar to that of American industry. Many corporate technology experts hold graduate degrees in fields such as Computer Information Systems (CIS) or Management Information Systems (MIS). Computer design and architecture is the province of those with a graduate education in computer engineering and science.

Graduate Education

An analysis of graduate curriculums for master's degrees in MIS and CIS has been conducted for this study. This was carried out by examining the list of post secondary institutions in each state normally considered as being in the service area of the Eastern Educational Research Association. From these institutions, those with curricula for master's degree programs in MIS or CIS were identified. One program was selected from each state. This selection is a convenience sample as the selection of institutions for inclusion was made on the basis of which programs provided a clear statement of their curriculum requirements.

The graduate programs in Management Information Systems, or Computer Information Systems, from a total of twenty universities made up the final sample. The core requirements for these graduate programs were examined, and a list of course requirements required by half or more of the universities was organized. The universities include: Auburn University, Boston University, Brown University, Central Connecticut State University, Cleveland State University, College of Charleston, Florida State University, George Mason University, Georgia State University, Howard University, Johns Hopkins University, Morehead State University, Long Island University (C. W. Post Campus), Marshall University, Mississippi State University, Old Dominion University, University of New Hampshire, University of North Carolina-Charlotte, Vanderbilt University, West Chester University (PA).

The course requirements that 10 (50%) or more of the colleges and schools of business have as part of the master's degree core include: Information Management (15), Network Management (13), Communications Systems, Telecom &/or Business Data (13), Data Base Design & Management (15), Computer Management (11), Computer Architecture (12), Human Factors & Consulting in Computers (10), Change Management (12), and System Security (10). An interesting observation was that specific course requirements familiar to educators in traditional master's degree areas such as research and statistics were in the minority and required by only seven programs.

National Vendor Certification

The need to be able to differentiate between people with appropriate skills and those who are not qualified is a central need at all levels of the information technology industry (Computing Technology Industry Association, 2006). Holding a national vendor certificate means an individual has successfully passed a rigorous examination that validates knowledge and ability in a particular area. The vendor credential is earned through passing either standard paper/pencil or hands-on laboratory practical examinations. Major manufacturers such as Cisco™, Microsoft™ and Novell™ offer certification credentials that are related to their products and services. For instance, Microsoft™ offers over a dozen credentials including the Microsoft Certified Systems Engineer for those individuals who design and support a Microsoft Windows environment.

Vendor certification is considered by corporate employers as actual proof of ability and skill. Most employers preferentially hire certified individuals over those who are not certified. Prometric (2003) explained that much like other high stakes examinations, the certification journey requires the candidate to go through a rigorous testing process. Unlike most test based certification programs in fields such as education, there are a series of vendor certification exams leading to even higher levels of qualification. The benefits of certification include: a sense of great achievement; increased self-confidence; professional growth; and maintenance of current targeted technical skills needed to install, configure, service, and maintain emerging technologies. In a minority of graduate programs, the required curricula include vendor certification as one option for students majoring in Information Systems.

The Computing Technology Industry Association also offers over 10 industry certifications ranging from hardware and infrastructure to electronic business and online security credentials for the Information Technology professional. These certifications are not vendor specific and provide the learner with the necessary technical knowledge to be successful in the field.

Methods and Results

A survey instrument was developed which was designed to answer the research question driving this study; *viz*., what tasks do leaders in educational technology see as being central to their current positions. After careful development the instrument was pilot tested by a panel of 17 content experts in the field who have served as school district technology coordinators. Any concerns raised by that process were resolved, and the final instrument consisting of 37 items was mailed to the Pennsylvania sample in January of 2004. Two additional follow-up efforts resulted in a final return rate of 84%.

The instrument was divided into three parts, one for demographics, a Likert scale to assess attitudes, and section to collect opinions and recommendations. Cronbach's alpha coefficient was used to determine the consistency (reliability) of the eleven items on the Likert type scale. That coefficient indicated that the Likert scaled portion of the instrument had relatively high reliability ($\alpha = 0.84$).

Of the 67 counties in Pennsylvania, only 24 eastern counties were chosen because they represent a sample that contains a broad spectrum of diverse and demographically varied representatives (Lesisko, 2004). Philadelphia County was removed from the population as presenting separate cases for analysis. From this group, sample of 102 of these technology administrators working in the schools of the eastern half of Pennsylvania was contacted to serve as respondents. A total of 86 returned (84% return rate) the survey instrument in a usable condition.

Outside of the large cities, Pennsylvania is a relatively rural state composed of suburbs and small communities served by small school districts. The mean (K-12) enrollment of the school systems included in this study was only 3,500. Analysis of the data from returned surveys indicated that about 80% of the technology leaders in Pennsylvania hold a teaching certificate, while 25% of this same group holds a national vendor certification credential. Of the individuals certified, 50% hold a Microsoft certificate while 30% holds a Novell credential.

Conversely, the research also revealed that 20% of the survey takers do not hold a professional teaching license from the Pennsylvania Department of Education. Of this group, 57% have successfully completed the requirements for a vendor credential. Moreover, 38% hold Microsoft, 21% Novell, 17% CompTIA, and 10% Cisco certifications. This implies that a Technology Coordinator is more likely to earn vendor certification if the individual does not hold a professional teaching certificate.

Survey respondents were asked to rank 7 items in order of importance as they related to technology coordination with 1 being the most and 7 being the least important. Survey takers were advised not to duplicate numbers. The data were analyzed by item. The rank order and median are displayed in the following table. The chart shows that Technology Coordinators are most concerned with providing technical support services for the district. They also feel strongly about helping educators to utilize technology in their classroom/laboratory and are interested in developing innovative ways to encourage the use of technology resources. Since providing technical support services for the district was the highest ranked item this may suggest that technology leaders are concerned with providing adequate support services (Lesisko, 2004).

Position Perceptions	Rank	Mdn
Provide Technical Support Services	1	2.00
Help Teachers to Utilize Technology	2	3.00
Develop Innovative Ways to Utilize Technology	3	4.00
Keep Current with Technology Trends	3	4.00
Help Students to Utilize Technology	3	4.00
Physically Work with Software	6	5.00
Physically Work with Hardware	6	5.00

Yet, despite the low ranking for “helping teachers” there is a second level of need that school systems have, and which is not addressed by the background and preparation of most technology professionals. What is clearly missing from the background of technologists is any formal or informal preparation for supporting curriculum and instruction in the schools. What these professionals lack is the ability to work with teachers and help them integrate technology into ongoing classroom activities.

One of the core areas of preparation in the graduate programs for professionals holding degrees in Management Information Systems (MIS) is “human factors” and “consultation.” The focus of this class is on making large corporate customers and engineers happy with a particular product. Only one institution, Long Island University (C. W. Post Campus), offered elective courses for MIS graduate students in the educational applications of advanced technology.

Conclusion

As reported earlier, having access to adequate technology support whether in education or a business environment can be critical to any organization. Survey data demonstrate that educational technology leaders are more likely to have earned a vendor certification and have a background in Information Technology than hold a teaching license. One reason for this is the widespread assumption that teachers are trained in how to deliver curriculum and handle classroom management, and that they can employ technology in those efforts “out of the box” without any assistance beyond that involved in wiring the classroom. The truth is that educators are not trained in providing their own technical support, and are not prepared to support a school based infrastructure that houses data, voice and video components.

Thus, the case can be made that there is a need for two separate professional certifications or educational specializations. Within school systems, like those of Pennsylvania, one person is needed who can work with the teaching and administrative professionals of the district in designing technology systems which integrate well into the various schools’ programs. This position requires that a professional educator with an appropriate background and education be given supervisory responsibility for district wide educational technology. This person should be certified as the Director of Education Technology. This administrator should have a background in education and be well educated in leadership, educational innovation, and curriculum development. A second area of knowledge and skill should include a background in information management, networking, internet applications, infrastructure, technology support, and systems security.

School systems also need to employ a second professional, the Network Administrator, who should have a graduate background in Information Technology or related field, as well as certification by a national vendor widely used by the school district. In many school districts this implies that this individual should hold certification by Microsoft™ as well as hold a master's degree in a technology related field. This professional should report to the Director of Education Technology. He or she should have the responsibility of system maintenance and serve as the in-house consultant for all systems, and be involved in all large scale software and hardware purchases.

In addition to these two professionals, school districts will need a group of technologists who can work under the leadership of the Director of Education Technology in curriculum development. A second group of technologists is required who will work with the Network Administrator on system maintenance and support. These latter personnel will perform the day-to-day tasks of maintaining the system and doing "as needed" repair work. The efficiency of their work is critical to the success of any educational technology effort.

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