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Integrating Technology to Achieve a Measurable Level of Learning

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ABSTRACT

The purpose of this paper is to detail the barriers to the integration of technology in US school systems. The barriers experienced by both individual teachers and to school systems as a whole are discussed. Student barriers, such as computer skill levels or poverty, are also discussed. In addition, this paper explains how technology should be used and the measurable benefits of doing so. Measurable benefits reported in the literature include increased performance on measures of reading comprehension, writing, components of IQ, transfer to novel tasks, and grade point average. Closing comments focus on how technology integration must be an ongoing process in order to become a successful endeavor.

INTRODUCTION

Today's educational system desperately needs technology integration to generate and maintain a modern learning atmosphere. Technology integration is the incorporation of technological resources and practices into the daily routines, work, and management of schools. Computers and software are two examples of technological resources. Others include network-based learning systems and technicians needed to design, implement, and maintain these other technical resources. Once the technological resources become available, the integration of those resources is possible.

School systems must begin now in order to ensure a bright future for the students who will glean the benefits from integrated technology. There have been very mixed approaches in the United States (US) regarding integration. Some states have been more successful than others.

It is the purpose of this paper to detail barriers to the integration of technology in our school systems. There are barriers to both individual teachers and to school systems as a whole. There are also barriers to the student, such as computer skill levels or poverty. This paper will also explain how technology should be used and the measurable benefits of doing so.

BARRIERS TO INTEGRATING TECHNOLOGY

With the proliferation of computers at home, work, and in our schools, it is no doubt that technology integration has become a subject of importance in education. Unfortunately, the acquisition of software and hardware is just the beginning of a very complicated integration process. This process includes reform of school policies and procedures. It even includes modifying the physical structure of schools to accommodate this new technology (wiring, storage, etc.).

Over the past two decades, the US has experienced a great deal of reform as the result of initiatives designed to integrate technology in our school systems. Even still, there are a number of barriers to this reform which include the following:

- Lack of hardware/software (computers, applications, internet access, etc.)
- Lack of security measures to prohibit children from accessing inappropriate material
- Lack of professional development for our educators

- Lack of time (for students and educators) to develop technology skills
- Lack of technology proficient support (peers, guru, administrator, etc.)
- Lack of administrative support (funding, budgeting, integrating technology into curriculum.)

In an effort to determine what the true barriers to integrating technology are, the National Center for Educational Statistics (NCES) has put together questions that measure the behaviors, practices, and preparedness of students, educators, and administrators (US Department of Education, 2000):

- Are educators/students proficient in the use of technology for teaching/learning?
- Are administrators/support staffs proficient in the use of technology for supporting teachers/students?
- Are technology proficiencies incorporated into educator/student assessment?
- Is technology incorporated into administrative processes (curriculum development)?

Even with the introduction of technology in our school systems, if the underlying support of this effort is weak, the integration will fail. One of the most common barriers to integrating technology is teacher preparedness and training. This barrier hinders the shift of integrated technology from simple drill, practice, and basic skills to a more proactive problem solving and in-depth learning. A study has revealed when the necessary hardware and software is readily available, teachers are not using them. The research has shown that technology integration directly correlates to the level of technology skills and knowledge of the educator (McCannon & Crews, 2000). The lack of skill and knowledge can lead to anxiety, which further diminish the use of technology in the classroom. To intensify the level of anxiety is the lack of development courses provided by the school system and the lack of support such as technologically proficient peers. This can be referred to as the dichotomy of the budget process because the acquisition of technology directly competes against the resources available for professional development (Staples, 2005).

As most studies on technology integration indicate, the acquisition of hardware and software is not the end of the road. Technology integration is an ongoing effort that requires integration in the school's policies, procedures, and curriculum. One of the biggest challenges for educators is they are given the opportunity to use technology in their curriculum, but there is no more direction than that. It is up to the individual educator to be enthusiastic, committed, and adventurous in integrating technology.

This integration of technology in the classroom should occur in two ways (Devi, 2002). The first is the teaching of the technology itself. There is an unfortunate expectation that teachers have the proficiency to do so. Instead, there should be a curriculum board or committee made up of school's technologically proficient educators. This board or committee should be visible by students and the public and available to train and educate the classroom teachers. The second way technology can be incorporated in the classroom is to use it to learn other subjects such as English, Mathematics, or Science. Educators and students should be rewarded and recognized for participating in activities that further integrate technology in the school system.

Another important barrier to technology integration is the lack of support in the budgetary process. This barrier can be breached by funding from PTO groups, federal and state grants, or by state lotteries. For example, according to the Georgia Lottery Corporation, over $7.6 billion has been given to the Lottery for Education Account to fund 850+ thousand students to attend college and 635+ thousand children to attend pre-K programs. In addition, more than $1.8 billion has been given to improve the infrastructure in Georgia schools (http://glc.georgia.gov). The administrator of the recipient schools has the responsibility to develop an integration plan that not only acquires hardware/software or provides professional development, but also to ensure that it is maintained financially and through continuous support.

Even with state lotteries, there are social-economic barriers. For example, NCES shows that even when technology is readily available, educators in low minority/poverty schools are less likely to use computers or the Internet (for creating instructional materials, communicating with peers, or educating students) (US Department of Education, 2000). Such barriers to technology integration are easily identified, but not easily solved. Here are other similar statistics provided by the Policy Information Center:

- While 85 percent of U.S. schools have multimedia computers, the average ratio of students to computers is 24 to 1, nearly five times the ratio recommended by the U.S. Department of Education.
- The ratio is about 9 to 1 in Florida.
- The ratio is about 63 to 1 in Louisiana (Coley, Cradler, & Engel, 1997).

Overcoming the barriers to technology integration is summed up by a quote from the NCES. "Leadership is the single most important factor affecting the successful integration of technology. This is true at the state level and at the school level. Schools which have made the most progress are those with energetic and committed leaders" (US Department of Education, 2000).

HOW TECHNOLOGY SHOULD BE USED

There are several ways that schools can integrate technology into the learning process. A review of the technologies that are being used and a discussion of some of the methodologies that have been used to implement these technologies are presented below.

Diffusion can be defined as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1983). This definition suggests that the people factor influences how and when a technology will be adopted. A successful methodology for the implementation of technology will require approval from all persons affected by the use of that technology. With this in mind, it is important that proper care is used when deploying technologies in a school environment.

Several characteristics have been found to affect the speed of diffusion of technology in schools. These characteristics are:

1. "Relative advantage: the degree to which an innovation is perceived as better than the idea that supersedes it.
2. Compatibility: the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters.
3. Complexity: the degree to which an innovation is perceived as difficult to understand.
4. Trialability: the degree to which a user may experiment with an innovation on a limited basis.
5. Observability: the degree to which the results of an innovation are visible to others." (Rogers, 1983).

The complexity of the technology can greatly influence its adoption because people relate the complexity to the ease of use (Elliot & Hall, 2003). Innovations that are perceived as ranking highly in all five of these characteristics, coupled with lower levels of complexity, will normally be adopted more quickly than others.

One pitfall to avoid when implementing new technologies is not to make unrealistic claims of what a technology should or will do. False expectations can decrease the perceptions of the actual value of using the technologies. It is important that the teachers are given information that shows why they should use a technology, and how that technology will be of interest to them (Elliot & Hall, 2003)

Massy and Zemsky (1995) describe four main barriers to technology adoption exhibited by a learning institution. First, norms may have been established, faculty autonomy may have been decided, or notions of productivity may have been expressed. Second, preferences may have been made about the spending of money on additional faculty members. Third, there may be few incentives for innovative teaching but several for research. Fourth, there may be a lack of a specific outcome and performance measures set to be achieved (Massy & Zemsky, 1995). Schools need to be aware of how to overcome these barriers when implementing new technologies.

For some time schools have been incorporating technology into the learning process. From electronic typing devices to virtual classrooms, where teaching is done through a medium such as the Internet, technology allows teachers to expand the classroom beyond the physical boundaries. Technology is a vital part of our lives, and some form of technology exists in almost everything we do. Although the earliest forms of technology integration into

school curriculums was referred to as the "computer-based drill and practice programs", which actually did not integrate well with the curriculum or classroom instruction, today's technologies can range from minor teaching enhancements to massive arrays of information available instantly (Himes, Pugach, Staples, 2005).

Students can have access to libraries of data quickly, which in the past required massive amounts of resources to accomplish such tasks. The decrease in the time that students and teachers spend looking for information increases the amount of time that can be used for learning (Peslak, 2005).

Word processing, games, e-mail, software designed for learning, interactive televisions, the internet, an intranet, computers, and CD-ROMs are a few of the common technologies that schools are choosing to implement. In recent years, several of these technologies have become increasingly available to the students. Schools are utilizing technologies to reinforce skills rather than using the technologies to re-order thinking (CEO Forum, 2001).

Companies that offer these technologies have sprung to the market in what looks like an overnight process, and they offer teachers and administrators several options to choose. Instructional technology has been a routine part of the learning process for several years; however, new innovative ways to implement technology surface each day. Each technology has its own significance, but some technologies prove to be more substantial than others in the school environment (Himes, Pugah & Staples, 2005).

No matter what form of technology teachers choose to use in their classroom, that form can usually be categorized into three categories. These categories are: "personal productivity aids, enrichment ad-ins, and paradigm shift" (Rogers, 2000). Personal productivity aids such as SPSS, which is a statistical software package, increase the productivity and speed of performing tasks. Enrichment ad-ins such as PowerPoint and the Internet make enhancements to presentations and class work. The last classification of technology integration in schools, the paradigm shift, is completely changing the learning activities to take full advantage of the technologies available (Hall & Elliot, 2003).

When selecting a methodology for the integration of technology, it is important to understand the technology is not a substitution for the personal interaction between the student and the teacher, but rather it should be an extension of the traditional classroom material. Properly implemented methodologies should reduce the time that the teacher spends disseminating information (Partee, 1996).

One technology that stands out as a leader of technologies that schools implement is the use of laptop computers. Students are given laptops, which are setup to work inside and out of the classroom (Himes, Pugah & Staples, 2005).

The degree to which a technology is accepted depends entirely on the support that the institution shows for it. The level of support for troubleshooting and connectivity that the school provides will influence the perceptions of the teachers and the students both. The school should provide the teachers with ample training and development opportunities. The school should also make sure the technologies that the teacher chooses to implement follows the school curriculum, and ensure that a stable infrastructure is in place for the use of the selected technology. It is often good practice for firms to appoint a technology committee to plan the school's technology implementation policies, but the schools should let the teacher choose how, when, and what technologies to implement (Himes, Pugah & Staples, 2005).

If teachers are not educated on the technology, they may be reluctant to use it. Teachers should be prepared so they are ready to respond to the influx of the resources they will have, and the schools should help keep up with maintenance that the technology requires so teachers will feel more comfortable with the technologies available to them (Himes, Pugah & Staples, 2005). The same is true with the student. If the students do not know how to use the technology, they often may not (Hall & Elliot, 2003).

Three practices that have been proven to support technology integration are: "alignment with the school's curriculum/mission, teacher leadership, and public/private roles for technology recognition" (Himes, Pugah, & Staples, 2005).

A growing question is who or how will schools afford these new technologies? Himes, et al. (2005) report that several of the schools in their study found grants that would help them pay for technology implementation. For example, the federal PT grant provided applicable schools with up to $32,000 to fund part-time specialists in the

schools. Other federal funding, such as the early childhood technology grant, is available to help pay for the hardware costs that the schools will incur. Schools should also budget for teacher training costs, hardware replacement, and repairs alongside the grants to keep the technology up to date (Himes, Pugah, & Staples, 2005).

MEASURABLE BENEFITS

Research and evaluation shows that technology can enable the development of critical thinking skills when students use technology presentation and communication tools to present, publish, and share results of projects. In a landmark study analyzing a national database of student test scores, Wenglinsky (1998) determined that technology could have a positive effect on students' mathematics scores. His study used data of fourth- and eighth-grade students who took the math section of the 1996 National Assessment of Educational Progress (NAEP). That NAEP included questions about how computers are used in mathematics instruction. After adjusting for class size, teacher qualifications, and socioeconomics, Wenglinsky found that technology had more of an impact in middle schools than it did in elementary schools (Valdez et al., 1999). In eighth grade, where computers were used for simulations and applications to enhance higher-order thinking skills, the students performed better on the NAEP than did students whose teachers used the technology for drill and practice. "He found that fourth-grade students who used computers primarily for 'math/learning games' scored higher than students who did not. Fourth graders did not show differences in test score gains for either simulations and applications or drill and practice" (Valdez et al. 1999, p. 24).

As noted by Coley, Cradler, and Engel (1997), when students used the Internet to research topics, share information, and complete a final project within the context of a semi-structured lesson, they became independent, critical thinkers. Using technology tools to build thinking skills is not just for the best and brightest students. The Higher Order Thinking Skills (HOTS) pull-out program, developed in the early 1980s to build the thinking skills of students, combined technology with drama and Socratic dialogue. Through this combination, disadvantaged students in Grades 4 –7 achieved twice the national average gains on reading and math test scores. Ten to 15% of the students also achieved honor roll status in 1994, suggesting a transfer of the students' cognitive development to learning specific content. The students who used HOTS also increased performance on measures of reading comprehension, writing, components of IQ, transfer to novel tasks, and grade point average.

In addition another independent study reflected that in schools that had more instructional technology and teacher training, the average increase in the percentage of high school students who took and passed the state Regents (college preparatory) exam in math was 7.5; the average increase in the percentage of those who took and passed the Regents English exam was 8.8. More importantly, using the reports from teachers and principals to determine the amount of technology available and in use in the schools, the study found that 42 percent of the variation in math scores and 12 percent of the variation in English scores could be explained by the addition of technology in the school.

CONCLUSION

In conclusion, there is a drastic need for the integration of technology in today's school systems. This enormous task is full of associated problems that must be addressed prior to beginning work on the integration. The task requires a great deal of support from many people and organizations in order to be successful. Financial need is great, but can be approached with innovative solutions, such as state lotteries or state and federal grants. Once the technology becomes available, system policies and procedures must mandate the inclusion of the technology into curriculums and must provide for the continuous support of the integration project. With the rapid changes in technology, the future implications are quite favorable. More students may go onto to earn higher educations via the web as result. Technology integration must be an ongoing process in order to become a successful endeavor.

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