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Myths and Realities About Technology in K-12 Schools

Only a clear-eyed commitment to using technology to help meet central educational goals will enable us to get a substantial return on our investment

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This article appears in 'The Digital Classroom: How Technology is Changing the Way We Teach and Learn,' a book-length special report from the Harvard Education Letter featuring articles and essays on topics such as professional development, distance learning, the digital divide, special needs, using technology to teach science, math, reading and writing, and much more. Authors include Howard Gardner, Chris Dede, Margaret Riel, and Larry Cuban. To order call 1-800-513-0763 or e-mail orders@edletter.org.

We are in the midst of an explosion of multimedia digital technology—computers and all that goes with them—in K-12 schools throughout the country. Propelled by federal, state, and local initiatives, schools spent an estimated $6.9 billion in 1999 on desktop computers, servers, routers, wiring, Internet access, software, and everything else involved in making modern technology available. Education funds are enhancing the bottom lines of Intel, Microsoft, Apple, Cisco, IBM, and other high-tech companies.

But will we receive an adequate "return on investment" to the *educational bottom line*? That is, will all this technology improve education for large numbers of students? Will it make our educational systems more effective and efficient? Will it help schools better prepare students for their lives in the 21st century?

As we begin this new century, the investment in technology for schools resembles the investments being made in many "dot-com" Internet companies. In both cases, the investments are based on the *potential* of new technologies, in the hope that this potential will be fulfilled in the coming years. And in both cases the investments involve significant risks and may be a long way from yielding adequate returns.

Maximizing our investment in technology requires a clear vision of our goals and well-developed plans for achieving them. Unfortunately, the rapid influx of technology into schools is, in many cases, running ahead of the educational vision and careful planning necessary to put technology to good use. In fact, what is being done is often based on misconceptions or myths about what is required to gain substantial educational returns.

Myth #1: Putting computers into schools will directly improve learning; more computers will result in greater improvements.

Computers are powerful and flexible tools that can enhance teaching and learning in innumerable ways. However, the value of a computer, like that of any tool, depends upon what purposes it serves and how well it is used. Computers can be used in positive ways, such as to help make learning more engaging, better address the needs of individual students, provide access to a wealth of information, and encourage students to explore and create—or in negative ways, such as to play mindless games, access inappropriate materials, or isolate students.

Many computers in schools, even up-to-date multimedia computers with high-speed Internet access, are not being used in ways that significantly enhance teaching and learning. There are many reasons for this, including the following:

- Teachers have not received adequate training and support for integrating technology into the core of day-to-day classroom instruction, so computers are used around the edges of the class's main work—for example, to reward students who complete their work quickly, to provide drills for students who are struggling with specific skills, or for occasional special activities. While these uses are beneficial, they don't justify the size of the investment.

- Teachers often don't have software that supports major curriculum goals, is consistent with their approaches to teaching, and is well designed for classroom use. While much good educational software has been developed, finding and obtaining what you need to run on the computers you have, and to fit into your curriculum, remains difficult in many cases.

- Technical support is often insufficient, so that if a computer problem occurs that the teacher and students cannot solve, there may be long delays before a technician is available to address it. Thus teachers feel they cannot depend upon the technology, so they do not plan to use it for important purposes in the classroom.

About the Author

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At EDC, he has directed several large scale projects funded by the National Science Foundation, the most recent of which produced the MathScape: Seeing and Thinking Mathematically middle school curriculum. He has been the education chair for the Harvard/EDC Leadership and the New Technologies (LNT) summer institutes, and directed the development of the related LNT web site. He now directs EDC's Center for Online Professional Education and the *EdTech Leaders™ Online* program.

- The ways in which computers are made available are often inconsistent with teachers' approaches to curriculum planning and classroom management. Many schools have been placing computers in every classroom, aiming for an eventual ratio of one computer for every six students. This requires teachers to organize daily activities so that some students can be working on the computers while others are engaged in other tasks—a style of classroom management that may be new to many teachers, especially above the elementary level. In schools without computers in the classrooms, teachers have to move the class to a computer lab, which must be scheduled well in advance. Since this situation makes it difficult to integrate computers into the flow of lessons, it often encourages teachers to treat computer activities as special events, rather than as central to the curriculum.

- In developing curriculum materials, publishers have not been able to assume that schools have sufficient computers or teacher expertise to make the use of technology central to the curriculum. Therefore, they have typically included computer activities only as optional supplements to other classwork.

The reality corresponding to Myth #1 is that all this expensive technology will yield little educational return until schools and districts address the need for professional development, technical support, the availability of appropriate software, classroom management, and curriculum integration.

Myth #2: There are agreed-upon goals and "best practices" that define how computers should be used in K-12 classrooms.

What educational purposes should computers serve in the classroom? When we explore this key question, we often find many different implicit views within a school or district. Unless these are articulated and clarified, and a consensus is reached, the diverging views can lead to conflicting expectations, approaches to implementing technology, and criteria for evaluating its impact, all of which can create barriers to moving forward effectively. The most common goals for using technology in schools include the following:

- Improve students' acquisition of basic math, reading, and writing skills, and content knowledge in specific subject areas, leading to higher scores on standardized tests. This goal often leads to the use of drill-and-practice programs, integrated learning systems (which provide online lessons and quizzes, adjusting the pace of lessons for each student), and software adjuncts to textbooks.

- Motivate students. This goal is often based on the view that schools need to use multimedia, visually rich materials to capture the interest of students growing up in a media-intensive world. In addition, technology can help teachers provide multiple paths to learning to fit individual students' learning styles and strengths. It can enable students to work with greater autonomy, collaborate with peers and mentors, and gain access to more information related to their own interests, all of which can help engage their interest.

- Broaden curriculum objectives, adding more problem solving, inquiry, project-based learning, and collaborative work. This goal often leads to students' using simulations, searching for information on the web, and preparing reports and presentations using word processors, data bases, computer graphic tools, and multimedia presentation software.

- Enable teachers to strengthen their own preferred approaches. For example, a science teacher who primarily lectures may use a computer and a large display to provide visual support for the lectures, while another teacher who favors a more inquiry-based approach may add simulations and experiments with computer-based measuring devices and analysis software.

- Better prepare students for the workplace. This goal often leads schools to add a technology strand to the curriculum, so that students learn keyboarding, basic computer operations, and standard applications such as word processors and databases. However, this approach does not address the major needs articulated by business leaders, who are concerned that their job applicants have strong skills in literacy, numeracy, and problem solving; know how to gather, organize, and analyze information; communicate well; work successfully in collaborative teams; and be able to learn effectively.

- Update education for the 21st century. Many believe that our changing world requires that we reconsider the very structure and culture of our schools and our classrooms, along with what we teach and how we teach it. Visions of the future vary widely, but most feature increased student autonomy, more collaborative work both face to face and online, more global connections, richer learning resources than traditional textbooks, and more inquiry, interdisciplinary, and project-based learning.

Of course, a school district may strive to meet more than one of these goals at the same time. But each goal selected will make demands upon resources—human as well as technological—and will lead to certain strategies for implementing and supporting the uses of technology. And, most importantly, different goals will lead to different criteria for evaluating whether the technology is used successfully.

So the reality corresponding to Myth #2 is that educational goals must be clarified and that plans for purchasing, using, and evaluating the impact of technology must be developed to fit those goals. We don't want the cart filled with computer hardware to be leading the educational horse.

Myth #3: Once teachers learn the basics of using a computer they are ready to put the technology to effective use.

Technology can affect what needs to be taught, how it can be taught, how classrooms are organized and managed, and the roles and expectations of both teachers and students.

That is, a technology-enhanced classroom may have both different goals and a somewhat different culture from a traditional classroom.

A long-term study of the Apple Classroom of Tomorrow (ACOT) project followed teachers over several years as they learned to use technology in their classrooms (with lots of computers, software, professional development, and support available). The researchers identified five stages of "instructional evolution" for using technology:

1) At the *entry* stage, teachers experience both trepidation and excitement as they learn to master the new tools themselves and begin to plan how to use them in their classrooms. They are often concerned about the time and effort required and wonder whether computers will ever be effective learning tools in their classrooms.

2) At the *adoption* stage, teachers begin to blend technology into their classroom practices, without making any significant changes to those practices. They may, for example, have students use drill-and-practice programs or word processors—tools that may fit easily into the current curriculum.

3) At the *adaptation* stage, the new technology becomes thoroughly integrated into traditional classroom practices. Word processors, databases, graphic programs, presentation tools, and content-specific software are used frequently. At this stage, teachers typically begin to see some real benefits, finding that students learn more, produce better work, and are more engaged in learning.

4) At the *appropriation* stage, the teachers understand technology and use it effortlessly in their own work and in the classroom. By now the teachers have difficulty imagining how they would function without computers.

5) At the *invention* stage, teachers are ready to experiment with new instructional patterns and ways of relating to students and to other teachers. Interdisciplinary project-based instruction, team teaching, and individually paced instruction become common. In the ACOT study, students of teachers at this stage began to show high levels of skill with technology, an ability to learn on their own, problem-solving, and movement toward more collaborative work patterns.

The ACOT study also documents the types of training and support that teachers need as they advance through these levels. Clearly, a basic introduction to computers supports only the first stage of this multi-year evolution.

The reality corresponding to Myth #3 is that for technology to be used fully in K-12 schools, significant changes are required in teaching practices, curriculum, and classroom organization; that these changes take place over years, not weeks or months, and require significant professional development and support for teachers; and that the needed levels of training and support change as teachers progress through these stages.

Myth #4: The typical district technology plan is sufficient for putting technology to effective use.

Almost every school district has a technology plan in place, often developed as a requirement to be eligible for federal or state funding. Typically, these plans specify a three-to-five year vision of what hardware, software, and networking capability will be purchased, along with some planning about teacher training, technical support and maintenance, acceptable use policies, and budgeting. Some plans also address integrating technology into the curriculum, evaluating the impact of technology on teaching and learning, and reviewing and updating the plan, but, unfortunately, these critical elements often receive only cursory attention.

Technology plans tend to turn technology into a goal in and of itself, and to separate it from other educational goals and plans. But technology is a tool, and technology planning is like planning for the purchase and use of construction tools—the first step is to design the structure to be built.

The reality corresponding to Myth #4 is that to use technology effectively we must fully integrate it into school improvement plans, special education plans, curriculum plans, professional development plans, and all the other plans formulated by schools and districts. Significant educational returns require that technology be viewed as providing tools to meet central educational goals, not as defining a new, separate set of goals.

Myth #5: Equity can be achieved by ensuring that schools in poor communities have the same student-to-computer ratios as schools in wealthier communities.

The federal E-rate program and many others have helped schools in inner-city and poor rural communities purchase computers and Internet access, with the goal of reducing what is often called the "digital divide"—the gap between "information haves and have-nots." While making the technology available is critical, it is only a first step. Recent studies have documented that teachers in poor inner-city and rural schools have significantly less training to use technology than teachers in wealthier schools, that technical support systems are not as well funded, and that the uses of computers in the classroom tend to be very different. Students in underserved communities are more likely to use computers for drill-and-practice and integrated learning system lessons, while students in other communities are more likely to use computers to support inquiry-based, project-based, and collaborative learning. The difference is very significant: for the first group, the computer is in control and leads the students through the lessons, while in the second group the students are controlling computers for their own purposes.

The reality corresponding to Myth #5 is that when considering issues of equity we need to examine all the essential conditions for making computers into effective teaching and learning tools, not just the number of computers purchased.

The central theme underlying all these myths is that while modern technology has great potential to enhance teaching and learning, turning that potential into reality on a large scale is a complex, multifaceted task. The key determinant of our success will not be the number of computers purchased or cables installed, but rather how we define educational visions, prepare and support teachers, design curriculum, address issues of equity, and respond to the rapidly changing world. As is always the case in efforts to improve K-12 education, simple, short-term solutions turn out to be illusions; long-term, carefully planned commitments are required.

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