Routledge
Taylor & Francis Group

Journal of Research on Technology in Education

ISSN: 1539-1523 (Print) 1945-0818 (Online) Journal homepage: https://www.tandfonline.com/loi/ujrt20

What Do We Do with These Computers? Reflections on Technology in the Classroom

Mark Goddard

To cite this article: Mark Goddard (2002) What Do We Do with These Computers? Reflections on Technology in the Classroom, Journal of Research on Technology in Education, 35:1, 19-26, DOI: 10.1080/15391523.2002.10782367

To link to this article: https://doi.org/10.1080/15391523.2002.10782367

What Do We Do with These Computers? Reflections on Technology in the Classroom

Mark Goddard
Washington State University

Abstract

Understanding how cutting-edge technologies have entered the classroom should be the first step teachers take before addressing the questions of how and why those technologies should be integrated with curriculum. This report advocates a progression of technology adoption by educators, administrators, and communities that leads to a judicious use of technology in the classroom. Computers in the classroom should support, not carry, the curriculum as a tool for real-world applications, inquiry, composition, and communication. Integrating technology with the curriculum fosters creativity, which, in turn, can lead to classrooms where engagement is nourished and learning enhanced. (Keywords: classroom, computers, engagement, integration, learning, technology.)

The mandate seems clear. Every school in America is reportedly connected (in one way or another) to the rest of the world through computer technology. The *Goals 2000: Educate America Act* (1994) authorizes state planning for improving student achievement through integration of technology into the curriculum. Standards for connecting curriculum and technology are being designed and implemented. As clear as this mandate appears to be, however, all across America blank computer screens stare out at teachers, and the teachers stare back. Educators seek answers to the following questions:

- What does computer literacy mean?
- How will teachers add another component to teaching when the available time to teach is ever decreasing (because of more time teaching to standardized tests, addressing special needs of students, and the increased time spent on class preparation and grading because of larger class sizes)?
- How can teachers obtain, learn, and use new computer technologies?
- What can teachers do to make the best possible application of technology in their classrooms?
- What exactly is driving the wedge between mandated integration of technology and actual practices in the classroom?
- Why are cutting-edge technologies entering the curriculum?

The early 19th century saw the first scientific linkage between early learning theory and educational practices of the day. Prior to John Dewey's ideas on education reform, an individual's education was either based on a need-to-know

The author wishes to thank Dr. Abbie Brown for his assistance and encouragement toward the consideration of meaningful technology in the classroom.

foundation (life skills) or provided at higher levels in the social arena of those embarking on a career in business, politics, and exploration.

As the education system became better defined, a specific curriculum was developed to see *who* could go to school. The essential question then was (and now is), "What needs to be known?" Curriculum tends to develop based on what is popular at the time, with an emphasis given to those elements that provide functioning skills to meet the social, cultural, historical, and economic needs of the time. The classic example of Russia's deployment of Sputnik and the ensuing ripple effect across the American educational system still exemplifies how curriculum is defined by moments of national need. The race to space triggered a surge of development in scientific and mathematics-based curriculum. The New Math of the 1960s was a direct result of the mathematics used by nuclear scientists during the proliferation of the nuclear technology that was pointed menacingly at the Red Threat of Communism. More recently, the efforts of companies such as Intel and individuals such as Bill Gates and Steve Jobs opened a world of technological advances viewed alternatively as a Pandora's Box and a New Age. Whatever the reform we deal with today as technology joins the classroom and curriculum, we would do well to remember that the changes we are faced with are rooted in our past. Neal Stephenson (1995), in his novel *The Diamond Age*, quotes Sir Charles Petrie (*The Victorians*), as follows: "Reform and deteriorations are moved by large forces, and they are mostly caused by reactions from the habits of a proceeding period. Backwards and forwards swings the great pendulum, and alternations are not determined by a few distinguished folk clinging to the end of it" (p. 1).

In addition to the cultural and historical influences driving cutting-edge technologies into the curriculum, various other factors are at play. As Henry Petroski (1992), in his book *The Evolution of Useful Things*, observes:

> If the world of design is understood to include not only things we can hold in our hands and operate but also the organizations and systems that produce and distribute those things, then we can explain virtually every generation and alteration of any artifact or technological system as being in response to the real or perceived failure of its antecedents to function as expected. (p. 248)

This central theme of Petroski's book speaks as well to educational reform and technological advances as it does to paperclips. Whether or not something is broken, we are impelled to fix, modify, and streamline it, make it faster, easier, and cheaper. As our social, political, economic, and historical foundations shift, so do our adaptations to the tools and systems we employ to function within shifting realities.

Our democratic and capitalistic foundations also play into educational reform (and consequently into the trend toward integrating technology into curriculum). These foundations create an atmosphere whereby private business can see the profit potential in offering short-term, inexpensive, market-intensive products and training that matches the digital millennium of educational reform.

Market-driven research and development of new technologies add more momentum to reform by increasing the number of innovations that are touted to improve our lives. The rapid and continued advancement of technology places enormous pressures on educators to provide students with the knowledge and skills necessary to lead productive lives.

This tendency is no different from the processes used to meet the needs of an emerging country 200 years ago; only the systems and tools have changed. Stephenson's (1995) *The Diamond Age*, though science fiction, vividly imagines a world where a nearly seamless integration of technology guides the educational and experiential life of children. Wherever we go, the complexity, dimension, and depth of our interface with technology increasingly becomes part of who we are as educators. The challenge, then, lies in our ability to decide how and what we should do to best use technology as it evolves.

WHAT SHOULD EDUCATORS DO TO BEST USE THESE TECHNOLOGIES?

Because teachers are the key to their students' success in the classroom, teacher requirements for mastering new methods, knowledge, and techniques with regard to technology deserve particular attention. Integrating technology into the curriculum is only a part of current education reform. There needs to be a progression of technology adoption and integration for the education community, as well. Despite different levels of adoption by individuals, experiencing discomfort when faced with change is a collective human dynamic. Our behavior is motivated in part by this internal dissonance, by a need to reduce the condition by changing our knowledge, attitude, or actions. Everett M. Rogers (1995), in *Diffusion of Innovations*, details a five-stage innovation diffusion theory whereby an individual may achieve knowledge, change attitude, and embrace actions toward using the new technology. The first stage, or Knowledge Stage, occurs when teachers are not technology users but are aware that it exists. At this stage, students may be users of technology, but they use it in ways determined by someone other than their teacher. For example, they may have computers at home or participate in computer labs outside the classroom. At this stage, the teacher's level of dissonance may be high.

The second stage, or Persuasion Stage, occurs when teachers are making their first interpersonal contacts with peers who they will tend to emulate, and hence, gain new information about the technology currently available. At this stage there is not necessarily information about the application of technology to the curriculum, but rather an introduction to technology as support for traditional productivity (i.e., grading software, correspondence, etc.). The school district may have mandated some level of computer integration for its schools, but the overall advantages and opportunities are not yet clear. The level of discomfort begins to decline as new information is assimilated.

The Decision Stage occurs when the teacher chooses to accept or reject the new changes. (Either accepting or rejecting a change relieves dissonance.) At the point of acceptance, teachers begin the process of adopting technology to assist

with traditional tasks and adapting the technological changes to enrich their curriculum. They begin to see ways technology might be connected to the curriculum, for example, by exploring Web sites, using CD-ROM encyclopedias, or doing word processing. Inquiry from the students tends to be teacher directed.

At the fourth stage, or Implementation Stage, teachers move from adaptation to an appropriation stage where technology is viewed as a relevant tool for teaching and learning. They may begin to design learning experiences and environments involving technology that will assist in achieving objectives and outcomes. A shift toward student-directed integration occurs at this stage to produce improvements in learning that allow students to master higher-order thinking skills, complex concepts, and skills they may not have otherwise encountered without technology. For example, students assigned to examine water quality in a stream near their school may use a computer to compile and graph data, send e-mail to contact governmental officials for land base data, or use the Internet to research historical impact of humans on a watershed. Students may also use technology to prepare and disseminate their findings in the form of reports or presentations (using tools such as PowerPoint [1987–2000] or a Web site), or merge their data with local or worldwide mapping projects.

In the final stage, or Confirmation Stage, teachers redefine the classroom environment and leverage technology to involve students in tasks that involve organizational skills and an ability to both master content and apply basic skills. Teachers not only begin to invent new applications for the use of technology, but they also collaborate with other teachers to create a unified use of technology across the curriculum.

Integrating technology into the curriculum is another area that educators should consider when evaluating how best to use technology. Although the economic and political forces that drive technology into the classroom appear to be an overriding trend, there is a concurrent trend to *not* let technology drive educational needs. This newer trend seems to arise from a growing concern about having a person-centered approach, or, as Donald Norman (1993) so aptly describes it in his book *Things That Make Us Smart,* "People propose, science studies, technology conforms" (p. 253). Although Norman speaks more to physical artifacts (tools we use) than to cognitive artifacts (tools that help us learn the thinking skills associated with reading, writing, and mathematics), his ideas transpose easily to the subject of integrating technology with curriculum. In the education setting, his person-centered motto might be recast as "educators propose, instructional design theories develop, and technology conforms." Posner (1995), in *Analyzing the Curriculum,* details five curriculum types that educators deal with simultaneously:

1. the Official Curriculum (that which needs to be known and is prescribed)
2. the Operational Curriculum (the actual teaching practices within a school)
3. the Hidden Curriculum (the institutional norms and values not openly acknowledged)
4. the Null Curriculum (the subjects not taught)
5. the Extra Curriculum (planned experiences that exist outside the official curriculum)

Tying the paraphrased motto from Norman (1993) with an awareness of the concurrent curricula an educator must consider gives us a glimpse at the initial considerations needed for integrating technology with curriculum. In other words, it is imperative that consensus in curriculum intent (educational purposes the school should seek to attain), methodology (the educational experiences likely to attain those purposes), changes to infrastructure (how experiences are effectively organized), and assessment (determining the extent to which purposes are attained) are agreed upon first. Once this agreement is reached, educators may begin to see technology as empowering rather than as something that is imposed upon them.

Application occurs when instructional technologies are treated as an innovation that is part of the agreed upon infrastructure changes and curriculum design. A variety of strategies can be applied to motivate teachers, diminish dissonance, and create an atmosphere of acceptance. The responsibility to meet expectations for integration should be given to the faculty, empowering them with the control to collaborate and develop curriculum strategies that incorporate available technology. Awareness, dependency, and comfort level are increased by eliminating status quo operations that are ineffective or inefficient. Finally, application should include clear expectations, training and placement, equipment and physical capacity, incentives, and methods of encouraging internal motivation.

The hurdles are not easy to overcome, and they differ from school to school. By aligning implementation with a person-centered philosophy, the integration of technology will be a subset of the overall curriculum. It will be adapted to a school's specific needs and a teacher's methodology, and teachers will be able to retain a focus that centers on the curriculum, with technology *supporting* rather than *driving* development. Teachers must first educate themselves and integrate technology into their personal teaching method before that technology can become an effective tool for educating students.

HOW SHOULD EDUCATORS USE THESE TECHNOLOGIES?

One of the most important questions educators must consider is how to measure human satisfaction with computers rather than measure the effectiveness of the computer as a teaching tool. As has been described, teachers normally advance through a series of motivational stages to incorporate technology within their methodology and curriculum. Students, likewise, need to find motivation, interest, and a reason for technology to advance their ability to learn. The human–computer interaction is a function of psychology as well as the specific technologies employed. It is a question of presentation versus learning style, with technology as the interface between the user and effective learning. With that in mind, the question of how educators should best use technology may be found within a framework for technology-based teaching and learning that focuses on engagement. For engagement to occur, the teacher must create an environment that encourages student–teacher contact, cooperation among students, and active learning. Teachers must provide prompt feedback, emphasize time on task, communicate high expectations, and respect diverse talents and

ways of learning. In their article "Seven Principles for Good Practice in Undergraduate Education," Chickering and Gamson (1987) further recommend that teaching be elevated to include student activities that:

- involve students in research projects
- encourage small-group discussions
- require in-class presentations and debates
- employ simulations
- create opportunities for individual learning projects

Ben Shneiderman (1992) has recommended eight rules for user interface design in software that apply equally well to the integration of technology into the curriculum:

- strive for consistency
- enable frequent users to use shortcut
- offer informative feedback
- design dialogue to yield closure
- offer error prevention and simple error correction
- permit easy reversal of action
- support internal locus of control
- reduce short-term memory load

A careful look at these rules for software development shows their importance in integrating technology with classroom curriculum. Students must be meaningfully engaged in learning activities through participation with others on worthwhile tasks. An educator who combines technology with engagement can create an atmosphere of student collaboration. Kearsley and Shneiderman (1999) describe this kind of classroom scenario as "Relate-Create-Donate." The Relate component emphasizes "efforts that involve communication, planning, management, and social skills" (Kearsley & Shneiderman, p. 1). Not only does the business community require these skills, but also the skills serve to help students work and learn on their own, creating an understanding of other people's diversity and perspective. The Create component incorporates learning in a "creative, purposeful activity." Student ownership in the creation of their own projects facilitates independence and ownership and provides them a sense of control over their own learning. The Donate component allows the students to make useful contributions to their fellow students, family, and community, providing them with a sense of "service" while increasing personal motivation and satisfaction.

These three components provide a method whereby individual learning styles, interests, and successes can be achieved, with technology conforming to the process and retaining the people-centered philosophy recommended by Donald Norman (1993). Technology—in the form of e-mail, online conferencing, Web databases, graphic organizers, and presentation medium—facilitates and supports the engagement process. If technology is used as a judicious tool that fosters creativity and communication, then teachers may well find that engagement is nourished and learning is enhanced.

CONCLUSION: FROM THE INQUIRY METHOD TO COMPUTER USE

Though the call has gone out for higher standards and challenging learning activities, many teachers are still sitting in their classrooms, staring at their computers, lamenting how change is icky. While politicians grapple with statewide standards and assessment, education journals continue to be filled with advertisements promoting technology. Research shows that there are an increasing number of computers being used in the home, an increasing number of technological advances available to schools, and huge investments by corporations to wire America. Change may be icky, but educators who capitalize on the relationship between technology and education reform can help students develop higher-order thinking skills and function effectively in a world beyond the classroom. The achievement of such monumental change requires a transformation not only of the underlying pedagogy but also of the kinds of technology applications to be used in the classroom.

In past years, software developers controlled content. The didactic technology applications designed to teach specific skills, usually in drill-and-practice format, have been offered as panaceas by the developers and corporate America, while educators wrestle with concept teaching under the pressure of meeting state standards and the demoralizing effect of statewide assessment. It is time to step away from this technology-centered focus and promote classroom learning activities in which students work in small groups rather than in isolation or as a whole class. The technology should be designed to support models of teaching that incorporate real-world applications, using research, design, analysis, composition, and communication.

Within the family of information-processing models of teaching, the scientific inquiry method (and the inquiry training process, in general) serves as but one example of a model that promotes strategies, values, and attitudes essential to inquiring minds. It is a model in which technology can serve to support rather than direct the learning process. Some of the instructional and nurturing effects of inquiry training include the development of process skills (observing, collecting, organizing, identifying and controlling variables, testing hypotheses, inferring, and concluding), active and autonomous learning, verbal expressiveness (communication), persistence, logical thinking, and a tolerance for ambiguity. The many process skills entwined throughout the inquiry method go well beyond the perceived application to science and are appropriate for a range of curricula, adaptable to all elementary and secondary areas because its essence is the art of inference. The inquiry method is highly structured. The teacher controls the interaction and prescribes the procedures, but simultaneously the students can feel in control of their own learning through cooperation and intellectual freedom. It is not difficult to imagine technology as a supportive learning tool in the process rather than as the sole, intimidating driving force.

Look again at some of our lead questions: "Why are cutting-edge technologies entering the curriculum" and "What can educators do to best use cutting-edge technology?" It is clear that all technologies evolve and change over time with the concurrent changes in social, political, and economic aspects of our world.

It is clear also that educational reform constantly evolves with the ever-changing swings between the methodologies, theory, and content that responds to societal need. Any technology, any change, is difficult to accept after having made the adjustment to past innovation, yet if overall societal needs are met, the new changes will be woven into the fabric of our present and will provide the platform for new changes in the future. It is the students' future toward which educators must turn their eyes, without making predictions of what might be. Teachers must prepare students for the changes they will certainly face. The teacher's responsibility lies not in staring at a blank computer screen while lamenting the changes that have been imposed, but to reach up and turn the computer on. The teacher's responsibility is to discover the judicious use of technology as another tool in the arsenal of teaching that will guide students to exploration, discovery, practice, appreciation, and wonder at the world they inherit. ■

Contributor

Mark Goddard is a licensed teacher and is currently in the master's program in the Department of Teaching and Learning at Washington State University. His focus is on at-risk youth and science education and on teaching preservice teachers how to teach science. (Address: Mark Goddard, Washington State University, Cleveland Hall 178, PO Box 642132, Pullman, WA 99164; mgbgt@wsu.edu.)

References

Chickering, A. W., & Gamson, Z. F. (1987, March). Seven principles for good practice in undergraduate education. *American Association for Higher Education Bulletin,* pp. 3–7.

Goals 2000: Educate America Act. H.R. 1804, 103rd Cong., 2d Sess. (1994). Washington, DC: U.S. Government Printing Office. Available: www.ed.gov/legislation/GOALS2000/TheAct/index.html.

Kearsley, G., & Shneiderman, B. (1999). *Engagement theory: A framework for technology-based teaching and learning* [Online]. Available: http://home.sprynet.com/~gkearsley/engage.htm.

Norman, D. A. (1993). *Things that make us smart.* Reading, MA: Addison-Wesley.

Petroski, H. (1992). *The evolution of useful things.* New York: Random House.

Posner, G. J. (1995). *Analyzing the curriculum.* New York: McGraw Hill.

PowerPoint [Computer software]. (1987–2000). Redmond, WA: Microsoft.

Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). New York: Free Press.

Shneiderman, B. (1992). *Designing the user interface: Strategies for effective human–computer interaction* (2nd ed.). Reading, MA: Addison-Wesley.

Stephenson, N. (1995). *The diamond age.* New York: Bantam Doubleday Dell.