EDUCATION WEEK

Can K-12 Education Drive On the Information Superhighway?

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If they build it, will we come?

If government, the telephone and telecommunications companies, and the cable industry join to develop the backbone of the information highway and its local access ramps, will schools and school districts invest in the local telecommunications infrastructure that will insure universal participation by the nation's more than 40 million K-12 students and their teachers?

Probably not. The federal government's goal to "extend the 'universal service' concept to insure that information resources are available to all at affordable prices'' may be a reasonable short-term policy for federal action, but it is at best only a first step toward the more appropriate goal of universal participation on the information superhighway by the nation's students and teachers.

The universal-service goal, which borrows an analogy from telephone service, means that governments use regulation to require private companies with regional monopolies to provide the public with access to minimal services at affordable prices. Still, after 100 years of telephone service and over 60 years of regulation, there are few telephones in schools today. Few school districts in the country have seen the educational and communication services on the telephone network that would justify both the continuing service costs and the up-front investment in a local school-based telephone infrastructure that would insure universal participation by students and teachers. Many more factors than access will be needed to justify an investment in a computer-based telecommunications infrastructure that provides the pathway to universal participation on the information superhighway.

The national debate on education stresses as its goals not just access to education, but instead high standards of what students know and can do. Active participation on the information superhighway is what will help students develop the planning,

interpersonal, informational, technological, and communication skills needed by the knowledge-based citizens and workers of the 21st century. If such skills are the goal of long-term federal policy for K-12 education, then universal participation is the appropriate strategic goal of federal policy.

Schools today face the dilemma of investing significant funds and incurring ongoing costs for a communications infrastructure before there exists the availability of sufficient educational services on the information highway that are cost-efficient and effective.

Yet, without widespread local school infrastructures, no one will invest in creating new educational-service companies. And without widespread and cost-efficient educational services, local school districts won't invest in local school infrastructures. This, of course, is the critical-mass, or chicken-and-egg, problem.

To solve the critical-mass problem requires the progressive and simultaneous development of:

1. The information superhighway and the "public right of way'' (highway and on-ramps).

2. A new industry of educational-service providers that deliver distance learning, curriculum, educational resources, project-based learning activities, and so forth (program).

3. The reorganization of schooling and schools (organization).

4. The local-school telecommunications infrastructure (local roads and vehicles).

Today K-12 education, despite the seemingly centralized governance of school districts and state systems, is effectively a cottage industry with 51 state units, 15,000 district units, and 100,000 school units. While global corporations like Citibank and large health-maintenance organizations use networks to rationalize and economize on the delivery of services, school districts and states exhibit little or no economic or organizational integration. These districts and state systems will have to evolve in a way that goes beyond their current governance and regulatory role to

use the new information infrastructure to provide services and bring about efficiencies.

Many companies are now eyeing the potential of the National Information Infrastructure, or N.I.I., as the delivery system for future electronic and video educational services such as customized curriculum, thematic units, customized textbooks, courses, modules, and electronic field trips. Some of these companies come out of the educational-technology sector, but most represent new alliances from companies in the publishing, printing, cable, and telecommunications sectors.

As a nation, we will need many experiments on the new design of schooling and the use of telecommunication-network services over the next few years to understand how to exploit its potential. These experiments will come from both government investment and from private-public partnerships. Despite the fact that the current Internet owes much of its development to prior governmental support, the N.I.I. of the near future will be largely a private venture and will swamp the current Internet in size and power. Universal digital access and the "public right of way'' for schools, libraries, and museums will come about less through government investment than through private development.

- Snags, barriers, and roadblocks on the information superhighway. Imagine what the information superhighway looks like to a teacher in one of our 100,000 K-12 schools in the United States. First, most teachers don't even know about it. Few have external phone lines, and most district business offices will not approve the open-ended purchase orders needed for phone service. Some teachers have phone lines, but have outmoded Apple II-E's or early I.B.M. personal computers as workstations, with interfaces that cannot support the newer software for easy navigation on the Internet. Some teachers have the phone line, a computer with an effective interface, a modem, and a connection, through a local university, to the Internet. But while they can communicate with colleagues in Moscow, they can do little with their primarily unconnected colleagues and students and parents of students in their own district. Few teachers in the country use computers that are on "local area networks,'' or LAN's, connected to "wide area networks,'' or WAN's, as is common in higher education, business, and the research community.

Many states are developing plans to give all schools access to the Internet. In most cases, this means dial-in access by single computers and modems and use of data, but not video, communication. Some states, like Iowa, plan a more extensive fiber-optic backbone with county points of presence to which local schools can connect, permitting both data and video communications. This is the kind of infrastructure states should build. This still leaves, however, two tasks for local school districts. First, districts will have to run the fiber to the "curb'' of the local school and, second, wire the school and build the in-school voice-, data-, and video-distribution system. For all members of a school community to "drive'' on the information superhighway, schools will need their own local telecommunications infrastructure, including an Internet server and router, cable, and satellite connections, and internal voice, data, and video distribution, all of which requires significant investment.

The costs of providing real access to all U.S. students on the future National Information Infrastructure are significant. The educational researcher Henry Jay Becker estimates the annual personnel, hardware, and software costs at nearly $2,000 per student for developing expertise in technology use among teachers and providing students with a learning environment characterized by project-based learning, gathering information from diverse sources, electronic communication with "students all over the world, with scientists engaged in real-world inquiry, and with data bases of enormous magnitude.''

That is nearly one-third the current annual cost per student in most U.S. school districts and would amount to approximately $90 billion in additional costs annually for all the nation's schools. Such an investment is unlikely to happen, except in wealthy districts or in schools and districts where there is a clear understanding that the up-front investment will yield real and rapid dividends, such as better and more appropriate student outcomes and economies in the costs of schooling.

- Getting to critical mass--building the 21st-century infrastructure for schooling. The first person with a telephone gets little productive use if his neighbors and family are without phones. The first person with a car in a remote region doesn't get much local benefit until his neighbors also acquire them and local society and government build roads for the local infrastructure. So, too, in schools, things don't take off until most teachers and most children are using technology to do their work, when they can

communicate with each other and with parents and community-based mentors as easily as pioneer technology-using teachers and students can today share data and reflections with counterparts in Moscow on the Global Lab project. Schools today lack the critical mass of skilled information-highway "drivers'' that will lead to organizational changes in schooling and to a new industry of educational-service providers.

To realize schools for the 21st century requires that state and federal governments develop the policies and investment that will spur local school and district investment in local-school network infrastructure and that will assist schools in the process of envisioning, reorganizing and redesigning themselves. Local communities will not make the enormous local investment in a school telecommunications infrastructure unless there is a clear public understanding of its perceived benefits.

- Government investment and regulation--tools to get K-12 to critical mass. While a government policy of universal service by itself will not realize a goal of universal participation, such a policy can, when combined with other measures, contribute to overcoming the critical-mass problem so that local schools and districts see the benefits in investing in a local telecommunications infrastructure. Government can contribute by being a customer of new educational services and can invest directly in, and promote through grants, the following:

1. Public educational information resources.

2. Long-range planning by states, districts, and schools.

3. Staff development.

4. Software and interface development for internetworking.

5. Project-based learning modules.

6. New educational enterprises.

7. Research on the effectiveness of the new learning activities and enterprises.

The federal government can increase existing support through direct National Science Foundation or National Telecommunications And Information Administration grants, through defense-conversion funds, through the Star Schools program, and through the U.S. Education Department.''

In the regulation sector, tariffs could be regulated and targeted subsidies established to enable school consumers less costly access to the information highway. The state of Georgia, for example, gives schools the same below-tariff telecommunications rate as state agencies and together with a less-than-one-cent surcharge, has generated $35 million annually for an education-technology trust fund.''

Government, however, must respect that the most significant investment in building the information superhighway and in initiating new educational services will come from the private sector, when private interests coincide with the public interest, and not because private-sector subsidies are specifically required by regulatory rules. Linkage requirements to builders of the information superhighway to give schools a "public right of way'' can, however, be used smartly to foster public-private partnerships between schools and the telephone or cable companies in which both sides win.

Robert Pearlman is the director of research of the Boston Teachers Union and a consultant on school restructuring and technology. A longer version of this article will be published as part of a forthcoming symposium report on "The Changing Nature of the Telecommunications/Information Infrastructure'' by the computer-science and telecommunication board of the National Research Council, the operating agency of the National Academy of Sciences.