CENTER FOR EVALUATION & EDUCATION POLICY

Education Policy Brief

Educational Technology in Indiana: Is it Worth the Investment?

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In this Education Policy Brief, the Center for Evaluation & Education Policy at Indiana University examines the necessity for future funding of educational technology in the state of Indiana and the relationship between technology and student academic achievement, the hallmark concern of the *No Child Left Behind Act of 2001* (NCLB). In particular, this brief addresses the following questions:

- Does the use of educational technology foster student academic achievement?
- How is educational technology being used in Indiana and across the nation?
- Is educational technology a cost-effective tool for Indiana's public schools?
- Given limited fiscal resources and the need to comply with NCLB standards, what are the most effective ways to utilize the technology already in place?

The core of educational technology—computers, software, and Internet access—and more recent resources such as digital textbooks, electronic whiteboards, and video conferencing, are found in many U.S. schools at all levels of education. Customary users of this technology include students, teachers, administrators, and instructional support staff. Additionally, parents are more frequently using it to maintain e-mail communication with teachers and administrators, to develop awareness of their children's curriculum, and to encourage the academic progress of their children. Although the role of technology in raising student achievement is still questioned, technology is firmly embedded in the U.S. educational system at the beginning of the 21st century.

The utilization of technology in schools can have both immediate and long-term educational, as well as workplace, effects. Due to increasing global interaction within and between education and business, and the use of technology to foster that interaction, technological literacy is essential to preparing today's youth to meet the demands of a global 21st century society. Increasingly, industry and the service sector are more reliant on technology, and colleges and universities expect incoming students to possess basic computer literacy as the use of technology continues to grow in higher education.

To help meet the challenge of preparing students for their vocations, states continue to support significant K-12 technology initiatives. For example, Grade 8 students in Cincinnati, Ohio, public schools are now able to apply to the district high school of their choice via computer, resulting in more educational options to better match students' long-term career goals.[1]

Michigan recently became the first state in the nation to require high school students to take at least one credit bearing or non-credit bearing online course as part of their graduation requirements, in preparation for online courses they may take as part of their postsecondary education.[2] In addition, the use of iPods for "coursecasting" is becoming more common as institutions of higher learning such as Purdue University and Case Western Reserve University utilize technology to deliver college course material in an anytime, anywhere environment. Coursecasting gives students access to the same material delivered in class, enabling them to stay current with the course, or to review as much as they need to for academic success.[3]

However, as school districts across the nation attempt to comply with the assessment tracking requirements of NCLB, the focus on technology in K-12 public schools has shifted from its application as an instructional tool in the classroom to a means for data management by teachers and administrators. In fact, a nationwide survey of 1,000 randomly selected K-12 teachers showed that while 85 percent of them used computers for record keeping, just over half of them integrated computers into their curricula. Although many of these teachers acknowledged technology as an effective instructional tool, most of their training has focused on administrative applications.[4] Likewise, the state of Indiana and its local school districts must bear the costs associated with NCLB and deal with economically based educational inequity, particularly as it relates to home access to computers and the Internet.

Hess (2006) contends that schools need to utilize technology in the same manner that business and government do, with the goal of optimal use leading to increased productivity (student achievement). He states that technology could streamline both educational processes and data management. For example, grading software could be used to assist teachers with basic assessments, and data management programs could make record keeping of student achievement outcomes more efficient.[5]

In a study of 30 K-12 teachers who were skilled with technology, Bauer and Kenton (2005) uncovered a number of other factors which prohibit teachers from utilizing technology to its maximum academic advantage. In particular, extra time is needed for teachers to plan the integration of technology into the curriculum and students need more time to work with computers. In addition, a lack of student technology skills, the need for up-to-date hardware and appropriate software, and the necessity of dealing with technical difficulties all negatively impacted the use of educational technology.[6]

THE DIGITAL DIVIDE

Researching the economically based digital divide, Warschauer, Knobel, and Stone (2004) studied eight southern California schools facing budget crises and an increasing number of immigrant students, and found significant differences in the way educational technology was utilized between high-SES (socioeconomic status) and low-SES K-12 schools. For example, low-SES schools employed fewer technology support staff to assist students, teachers, and administrators. Teachers in low-SES schools also had a higher propensity to use computer-based homework for lower-order tasks, and they tended to use computers for test preparation rather than for developing academic content knowledge.[7]

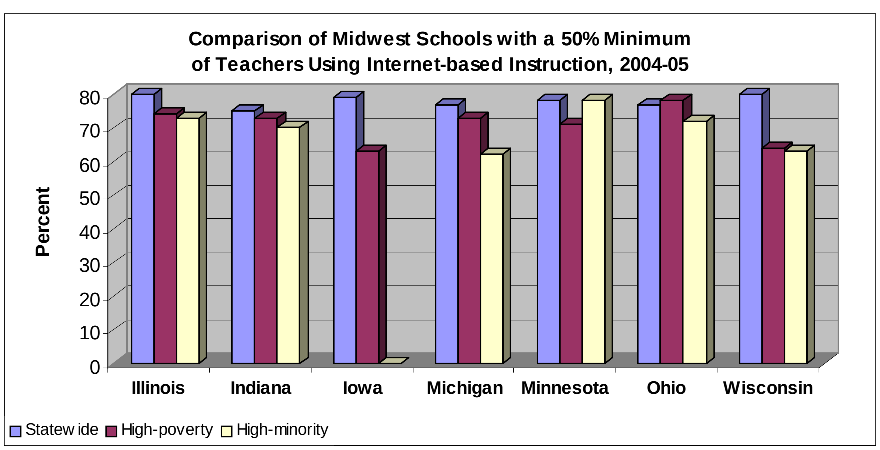
To illustrate how Indiana compares to other Midwestern states in addressing the digital divide through Internet-based instruction, Figure 1 shows the percentage of schools which have at least 50% of their teachers using the Internet for instruction. Within the state, poor students and minority students are slightly less apt to encounter this type of instruction than are students in general. Although Indiana provided the least amount of statewide Internet-based instruction, differences between it and the other states were small. More significantly, Indiana appears to be the most equitable in terms of the differences between populations.[8]

Warschauer et al. also state that access to computers and to the Internet within U.S. public schools is no longer a primary concern; however the lack of home access to computers and the Internet, the purposes for which technology is used, and the ways in which it is used have become salient issues.[9]

For example, in a survey of over 29,000 children, DeBell (2005) found that access and use of computers varied slightly among different groups of students in pre-kindergarten through Grade 12. However, he found that students coming from low-SES homes and households in which parents had less than a high school credential were about half as likely to use the Internet (at home or at school) as those coming from higher SES homes and homes with parents having at least a high school education. Likewise, students in African American, Hispanic, or Spanish-only speaking households utilized the Internet at half the rate as did other students.[10]

Fairlie (2005) claims that the lack of home access to computers and the Internet may be negatively associated with student achievement. Using nationally representative random sample data, he found that

Figure 1



Adapted from *Education Week Technology Counts 2005.*

teenagers who do not have access to a home computer are less likely to graduate from high school than teenagers who do have access. While 85.5 percent of white students utilize home computers (with 77.4 percent of those Internet connected), just over half of all African American and Hispanic students have a computer in the home, and only about 40 percent of these children have home Internet access.[11] Fairlie states, "These disparities in access to technology are troubling because of the growing importance of technology skills for succeeding in the labor market."[12] For more information on Dr. Fairlie's research, please see his Policy Perspective on page 9.

THE ACADEMIC EFFECTIVENESS OF EDUCATIONAL TECHNOLOGY

Empirical Research

Is educational technology academically effective? A review of the research literature demonstrates the need for an increase in better designed empirical studies that can help answer this question, but as Schrum (2005) explains, it is difficult to conduct studies in the K-12 setting for a number of reasons. For example, researchers must face the ethics involved with denying potentially good practices to some students who would serve as control groups. Also, the logistics of classroom dynamics do not easily allow for the maintenance of experimental conditions, and students' access to technology outside of school, which could influence how they use technology in the classroom, cannot be easily accounted for.[13] In addition to these concerns, studies vary greatly according to the research methodology used, the individual differences between students in the studies, and the types of programs studied.[14]

Therefore, much of the literature discusses non- or quasi-experimental studies, or those sponsored by private software vendors which have not been independently verified. Kulik (2003), however, reviewed a number of controlled evaluation studies on the effects of technology on K-12 reading, writing, mathematics, and science. (Only Kulik's reviews of studies published throughout the 1990s are noted in this brief.) Studies of three types of computer-mediated reading programs yielded mixed results regarding reading improvement. Depending on the age of the students and the type of program utilized, increases in student achievement ranged from negligible to strong, with younger students sometimes showing greater improvement than older ones. For example, kindergartners in a computer-based writing-to-read program improved their reading levels equivalent to an increase from the 50th to the 80th percentile. Several studies on the use of computers for word processing generally yielded moderate increases (e.g., from the 50th to the 62nd percentile) in student writing skills. Similarly, Kulik's review of 36 controlled evaluation studies of mathematics and the natural and social sciences yielded mixed results. Some studies demonstrated moderately positive increases in academic achievement, others no change, and still others yielded negative academic results when compared to classes not utilizing computer technology.[15]

MacArthur, Ferretti, Okolo, and Cavalier (2001) reviewed 47 studies conducted between 1987 and 1999 which focused on computer-based technology for developing word identification, text comprehension, and writing by K-12 students with mild learning disabilities. Like Kulik, these authors also report mixed results. Relative to a control group in each study, MacArthur et al. found evidence that some technology-based programs can be used to teach phonological awareness and decoding skills to children. Likewise, screen-reading software (using speech synthesis) may help students with word recognition, and enhanced electronic texts can help poor and average readers improve their text comprehension. Technology may also be used to help learning disabled students improve their writing, although developing the keyboarding skills necessary for writing via computer could be burdensome for some students.[16]

BEST PRACTICES AND INITIATIVES ACROSS THE COUNTRY

Although more empirically based research is needed, programs from across the U.S. provide examples of how educational technology is being utilized to promote academic achievement. For example, Eaton (2005) describes a technology-based comprehensive reading program implemented in a Canton, Ohio, elementary school which has nearly 80 percent of its students coming from economically disadvantaged homes. In fall 2003, Grade 3 students had a passing rate on the state reading test of 37.5 percent. After implementing the initiative *Destination Success*, the school experienced a one-year, 124 percent increase in the passing rate. By spring 2004, 84 percent of Grade 3 students passed the state reading test, and the second-year implementation also yielded a passing rate of over 80 percent. The success of the program was attributed to envisioning and implementing a comprehensive technology plan which closely matched the state's standards for academic reading with the tutorials and assessments used in the program. Furthermore, the curriculum was carefully chosen to ensure that the technology used would support it and a program was selected that would foster student engagement with the educational materials. Technology served as a tool for the whole classroom, rather than as a separate component for use in computer labs. Extensive training was required of all faculty, administrators, and educational support personnel, who were given broad access to technology personnel. Given its success, the program is being implemented in all Canton elementary schools during the 2005-06 school year.[17]

Mosser (2005) reports that the state of Georgia has implemented several initiatives to improve the use of technology in its public schools. For example, *Teaching in the 21st Century* is a course in which teachers' technology skills and preferences for different types of technology are assessed, and they are provided an opportunity to try new technology. Teachers develop their own "environment" to demonstrate how education could be improved through technology and they can use a state-sponsored Web site to find free resources including technology-based lesson plans and other materials that fit with the state's standards. Georgia has also implemented a virtual school which gives access to 65 courses to all public, private, and homeschooled students, and it is providing two Advanced Placement (AP) courses for every high school. In addition, the state has set up research programs in 12 schools which are evenly distributed across grade levels, socioeconomic boundaries, and major subject areas, so that the effectiveness of educational technology can be studied.[18]

Another statewide program that has proven to be successful is Utah's *Electronic High School*, which has more than 35,000 students participating in its online classes.[19] The school, fully accredited by the Northwest Association of Accredited Schools, offers diplomas to state residents who are homeschooled, to students who have left school and their class has already graduated, and to those who have been referred by their districts for completing the electronic diploma. Operating since 1994, the school's courses are free to all in-state students, and are available at a nominal fee for out-of-state students. The competency-based curriculum is characterized by an open-entry and -exit policy, so that students can normally register any day of the year and complete their courses in their own time, usually within one year.[20] The high school offers both academic and elective courses. Academic courses include computer science, world languages, fine arts, language arts, mathematics, science, social studies, healthy lifestyles, and driver education; elective courses include agricultural science, business/economic education, family/consumer science, health sciences/technology, marketing education, and technology/engineering.[21]

Furthermore, Utah's Educational Technology Web site has integrated, well-defined technology standards for K-12 students, and provides its students with educational technology core courses beginning in Grade 3.[22] Students are formally assessed on technology literacy from Grade 5 through Grade 12. All assessments, which match the specific technology literacy standards for each grade, require a keyboarding test, a self-assessment of technology literacy, and at least two examples of student work included in an electronic portfolio.[23] The state also offers teachers a K-12 computer science endorsement,[24] and teachers who are a school's technology teacher are required to complete an educational technology endorsement.[25]

Another state that is frequently cited for its comprehensive educational technology initiatives is the state of Maine. The Maine Department of Education administers a number of educational technology programs. There are five education programs that make up the core of Maine's education technology programs, including the Maine Distance Learning Project, which provides 28 high school courses online; Maine's virtual library, MARVEL!; the Maine School and Library Network (funded by E-Rate and the Maine Telecommunications Education Access Fund), which provides universal broadband access to all of Maine's schools and libraries; the Computers for Schools and Libraries Program which provides schools with donated computers refurbished at the Windham Maine Correctional Center; and the nationally recognized Maine Learning Technology Initiative (MLTI). In its fourth year, MLTI provides one-to-one wireless networking and laptop computers to about 68,000 students in Grades 7 and 8 and to over 3,000 teachers in every Maine middle school; teacher and technical training is also available throughout the school year. In addition, approximately 60 percent of these schools allow students to take laptops home. For those without wireless access at home, the Maine Learning Technology Foundation uses private funds to provide dial-up Internet access to students who qualify for the Federal Free and Reduced Lunch Program.[26] In surveys of over 1,100 teachers and 16,000 students conducted in 2005, a strong majority of both groups credited the use of laptops with a variety of improved teaching and learning experiences.[27]

Other examples of K-12 technology implementation are described by the U.S. Department of Education at its National Education Technology Plan Web site. Please see the Resources section on p. 12 for information on initiatives sponsored by the Plan.

EDUCATIONAL TECHNOLOGY IN INDIANA

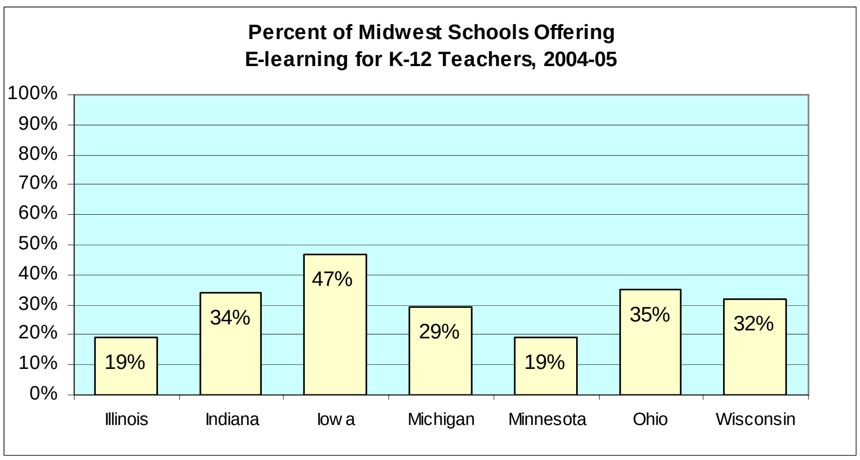
General Characteristics

In accordance with Indiana Code 20-20-13-7, every school corporation in the state must maintain a current, state-approved, three-year technology plan.[28] Among other requirements, each Indiana school district must demonstrate how technology will be incorporated into the curriculum, provide a description of in-service training, and develop a schedule for the maintenance and replacement of equipment and infrastructure. Without the plan, school corporations are not eligible to receive federal funding available through NCLB Title II, Part D (discussed on p. 6);[29] cannot use money from the school corporation's Capital Projects Fund for an educational technology program, nor are they eligible to apply to the state for low-cost technology loans from the Common School Fund.[30]

Indiana is ranked among the top 20 states for leadership in instructional technology at the national level according to Education Week's Technology Counts 2005.[31] (This annual report provides a state-by-state assessment of educational technology-related physical resources, support services, and education standards and practices in K-12 public schools in the U.S.) For example, Indiana's education standards for the 2004-05 school year included technology standards for students[32] as well as teachers and administrators,[33] although neither technology training nor tests for either initial certification or recertification of administrators and teachers were required. However, Figure 2 illustrates that Indiana compares favorably to other Midwest states in its provision of technology-based professional development for its teachers.[34]

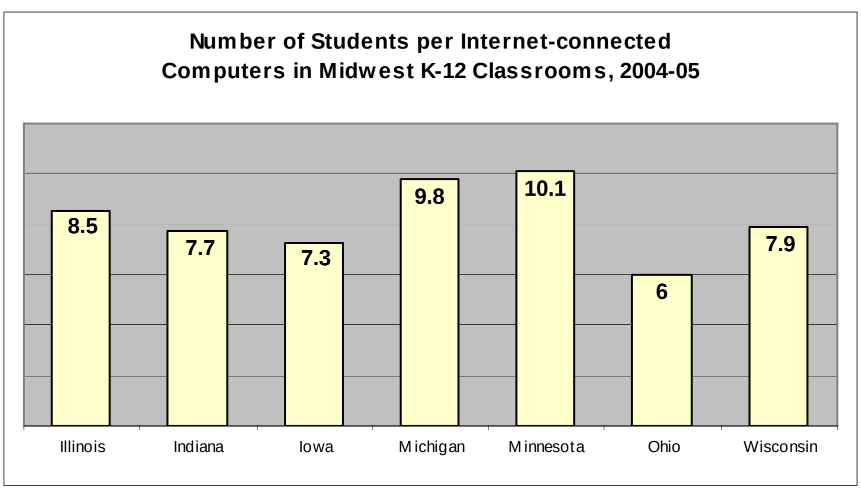
In the 2004-05 school year, the state also regularly collected data on educational technology in the schools and had a mechanism in place to update or replace educational technology.[35] Furthermore, computer-based end-of-course assessments were offered in Algebra 1 and Grade 11 English, and the state is planning to increase online assessments in the future. Initial reaction to the online testing from teachers was generally positive because teachers were able to utilize test results more quickly for the revision of their classroom practices.[36] In addition to Indiana's relatively low student-to-computer ratio of 3.2 students per instructional computer in the 2004-05 school year, virtually all of the state's public schools (99 percent) provided Internet access for students, although slightly more than half of the Internet-connected computers were located outside of classrooms.[37] The state's goal is to implement one-to-one computing across the state through the Indiana Access Program, which uses lower-cost desktop, rather than laptop, computers.[38] For more information on one-to-one computing, please see the next section and the Policy Perspective shared by Michael Huffman, Special Assistant to the Indiana Superintendent of Public Instruction, on p. 8.

Figure 2



Adapted from *Education Week Technology Counts 2005*.

Figure 3



Note: A smaller number indicates a better student-to-computer ratio.
Adapted from *Education Week Technology Counts 2005*.

The Indiana Access Program

As of 2004-05, Indiana had a 7.7:1 ratio of students to each in-class, Internet-connected computer. (See Figure 3 for a comparison of Indiana to other Midwest states in this regard.)[39] However, once Indiana Access is fully implemented, the state expects to have the lowest ratio of all Midwest states. According to Huffman, classrooms in 24 high schools across the state have already been set up with individual desktop computer workstations using the Linux operating system. The workstations, which also serve as regular classroom desks, have been designed so that the monitors do not obstruct the teacher-student view. In developing this plan, it was important to ensure that the program was scalable (able to serve the greatest number of students), sustainable, and repeatable. Desktop computers typically last longer than laptops, and initial installation of desktops and estimated replacement costs for them are one-third that of laptops.[40] Although low-cost laptops may be coming in the future, Indiana's students need to develop their computer literacy skills now so they can meet the real-world challenges of today's workplace.

Other K-12 Technology Programs in Indiana

In addition to Indiana Access, there are a number of technology-related education resources and programs designed to assist students, teachers, administrators, and parents with improving academic achievement in Indiana. The following represent a sample of what is currently available:

- *Buddy^2* is the second generation of the Buddy Project, which was a national showcase program when it began in 1988. The purpose of this program is to develop and facilitate learning projects in K-12 school communities in order to increase student achievement.[41] Parents, teachers, and students can find numerous educational activities, lesson plans, and links to educational resources at the Buddy[2] Web site.

- *Project Home Town Indiana* exists to encourage the study of Indiana history in the K-12 context and to demonstrate how the Internet can be used to complement classroom instruction. This statewide project, sponsored by the IDOE Department of Learning Resources, brings students into an online collaborative environment that involves legitimate subject matter which both satisfies curriculum standards and promotes pride in Indiana history.[42]
- *The E-learning Academy*, administered by the Indiana Department of Education, provides a variety of free services for teachers and students in both public and non-public Indiana schools. These services include onsite technology training on a number of different topics for educational staff and a Web site where teachers can construct their own Web sites to post class assignments and activities. Both teachers and students (with teacher or staff authorization) can access on-line assessments for fundamental computer applications and Grade 4 and 8 mathematics. The Academy also acts as an interface between parents and a third-party company so that parents can access their children's academic records.[43, 44]
- *INSPIRE* is a virtual library developed by the Indiana State Library. It is available to all Indiana residents regardless of educational status, and is accessible from the Internet at home for those with an Indiana Internet service provider. The library consists of various information resources and a collection of commercial databases, which can be used by parents to assist their children with schoolwork.[45]

See the Resources section for Web site links related to these four programs.

In addition to these programs, the following two recent initiatives have been established to help Indiana high school students transition to higher education:

- *Indiana e-Transcript* enables students to electronically submit their transcripts to prospective colleges. The program, the first of its kind in the U.S., will greatly reduce the amount of processing time between transcript request and delivery. It is fully funded by the nonprofit organization, Indiana Secondary Market for Education Loans, Inc.[46]
- Indiana State University's *Technology Scholarship Program* will award laptop computers to incoming freshmen who achieved a high school GPA of at least 3.0 and who also earned a Core 40 Diploma. This program will help to provide the laptops that will be required of all incoming freshmen beginning in the 2007-08 academic year.[47]

FUNDING AND EDUCATIONAL TECHNOLOGY

The Cost Effectiveness of Educational Technology

According to Dr. Barbara Bichelmeyer of the Indiana University Bloomington School of Education, determining the cost effectiveness of educational technology is a "very difficult question…there are no known [K-12] studies" which address this issue.[48] Although focusing on higher education, Johnstone and Poulin (2002) state that before being able to address cost effectiveness, it is necessary to address the measurement of cost, for which, they claim, there must be a generally accepted method of accounting. Costs go far beyond faculty, software, and transmission systems, and include such services as academic, computing, and telecommunications support, with scalability and course development the two most important factors in determining technology costs. Developing technology-based or mediated curricula that can be used by as many students as possible makes financial sense, just as does using the same textbooks in different schools in the same district.[49]

Although Hawkes and Cambre (2000) focus on interactive distance technology, distinguishing between tangible costs and intangible costs may also apply to K-12 in-class instruction. Tangible costs include, for example, physical infrastructure, building renovation, and technology maintenance, while one example of an intangible cost is the stress that teachers experience in their adaptation to technology. The authors state that cost-effectiveness is difficult to determine because identifying educational benefits deriving from the use of technology, which may take a minimum of two years, is necessary before a cost benefit analysis can even be considered. However, the authors report that in response to a survey, educators suggested alternative approaches to traditional cost benefit analyses, such as documenting the benefits that technology can have on student motivation through active engagement with learning, and increased collaboration and tolerance as a result of telecommunication applications.[50]

Funding for Educational Technology in Indiana

Educational technology in Indiana is supported through a variety of sources at the federal, state, and local levels, but funding concerns at all levels of government threaten to severely limit support for the continued integration of educational technology in public schools in the state and across the country.[51] At the federal level, funds are provided through the *Enhancing Education Through Technology Act of 2001* also known as Title II, Part D of NCLB.[52] However, these Educational Technology State Grants (which can be used at the state, district, and local school levels) dropped from a nationwide total of $496 million in fiscal year (FY) 2005 to almost $275 million in FY 2006, a decrease of over 55 percent.[53] Indiana's portion from this federal grant was reduced from almost $6.4 million in FY 2005 to an estimated $3.8 million in FY 2006.[54] Figure 4 on page 7 illustrates the change in federal funding for Indiana from 2001 to the present.

Another source of federal assistance for educational technology is the E-rate program. Managed by the Federal Communications Commission, this program was designed to help schools and libraries acquire telecommunications services and Internet access by providing discounts to states of 20 to 90 percent for these resources out of its potential $2.25 billion annual budget.[55] Indiana receives an average annual discount equivalent to approximately $22 million from the E-rate program;[56] after the discount is applied, the balance of the actual funds needed to provide these services is allocated from the budget of the Indiana General Assembly.

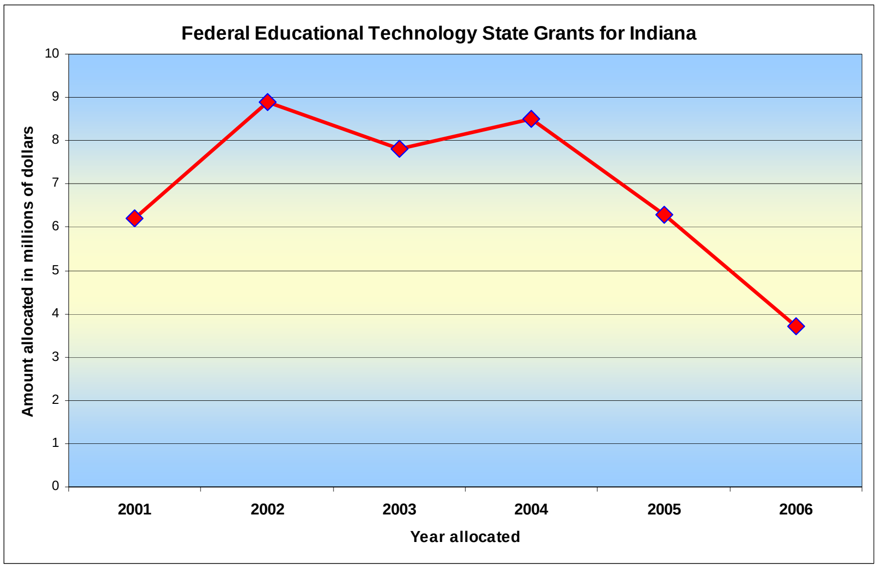
At the state level, funds for educational technology are allocated in the biennial state budget. For the 2005-2007 biennium, the General Assembly has approved a budget of $9.2 million, including $5 million for the Technology Plan Grant Program, which assists Indiana school districts with completing the goals of their technology plans through the purchase of hardware and infrastructure, including the components needed for telecommunications. This funding is distributed in rounds, so that the allocation of funds begins with low socioeconomic schools. In fiscal year 2005, 86 school corporations shared in this program.[57]

The budget has also allocated $4.2 million for IDOE's Educational Technology Program which includes K-12 resources such as Buddy[2] and the E-learning Academy, as well as IDOE staff, including the operation of the Office of Special Assistant to the Superintendent of Public Instruction for Technology.[58, 59]

Figure 5 illustrates the amount of annual funding from 1996 to 2003 which was appropriated for educational technology by the Indiana General Assembly. The funding included the IDOE's computer learning and technology fund, the Ed Tech Fund, Buddy[2], E-learning Academy, INSPIRE, and other projects. Funding for years 2003-05 included IDOE's computer learning and technology fund, the Educational Technology Fund, INSPIRE, and the Technology Plan Grant Program; all dollar amounts are rounded to the nearest million.[60, 61]

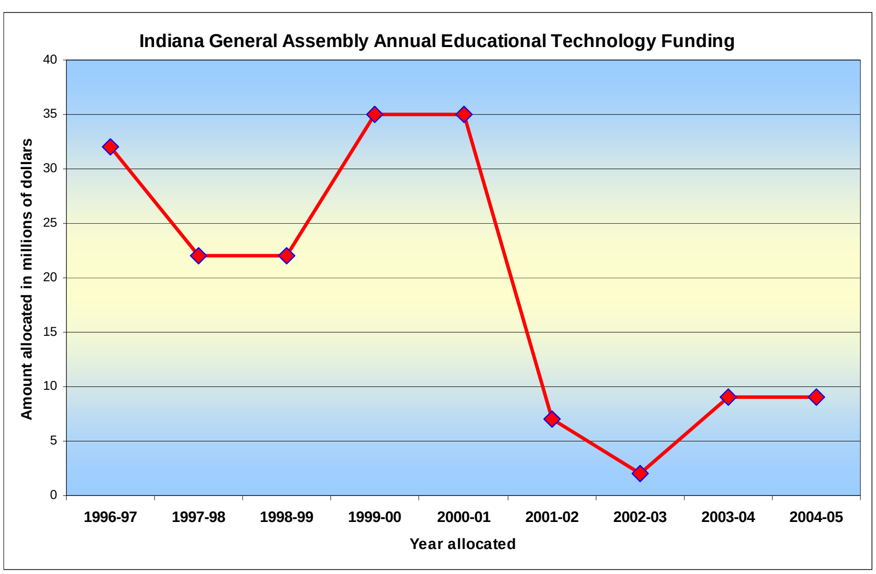
In addition to these funds, schools may also be eligible to apply for low-cost technology loans from the School Technology Advancement Account, under the Common School Fund. For the 2005-2007 biennium, $10 million is available for these loans. The funds received from these loans must be used to purchase computer hardware and software that is primarily used for instructing students, and to develop and implement innovative technology projects.[62] At the local level, school corporations' Capital Projects Funds, derived from property tax revenues, provide for educational technology at an estimated total annual average of $80 million statewide.[63]

Figure 4



Adapted from the U.S. Department of Education (2005).

Figure 5



Adapted from the Indiana Department of Education (2005).

Policy Perspectives

INDIANA ACCESS PROGRAM

Mike Huffman

Indiana's one-to-one computing program is the first of its kind in the nation and its goal is to equip Indiana high school students with a computer in core subject areas for use on-demand. As one-to-one takes hold in Indiana high schools, schools may be able to consider relocating current computers to lower grade levels, thereby making them more accessible to middle schools and elementary students.

Funding for this initiative comes from available Technology Plan Grant funding, federal funds, and funds from other sources. The concept of one-to-one computing has been attempted before, and states such as Michigan, Maine, and New Mexico have attempted one-to-one using laptops. Although these programs have shown tremendous benefits for schools, parents, and students, most of them, as of today, are being curtailed due to budget considerations. Indiana's program uses desktop computers instead of laptops.

The CPUs currently used in the pilot program are basic systems that have a 40 GB HD, 256 MB of RAM, a CD-RW drive, on-board video, audio, LAN, USB 2.0, a diskette drive, a 2.4 GHz processor (or better), a keyboard, and an optical mouse. These systems cost about $275.00 and come with a one-year warranty. In all respects, this is a "commodity-priced" computer; future models may include more RAM or other slightly modified configurations. The goal is to stay within the $250.00 to $300.00 (or lower) price range, with functionality that addresses current needs.

Placing computers in a one-to-one environment in language arts classrooms has several key benefits for Indiana schools. Professional development can focus on subject-specific activities and teachers will be better able to take advantage of sharing resources among themselves. The benefits to students will come in terms of more opportunities to write, research, and explore real-world skills they will need as they graduate from high school and move on to higher education. Other tangential benefits exist as well, such as the increased opportunity for schools to participate in end-of-course assessments and other activities that require a high density of computers.

While price is a driving factor in the initial procurement, the curriculum is the driving factor once the systems are in place in classrooms. Furthermore, staged implementation of this program will allow schools to better handle issues of electrical, cabling, and other infrastructure needs, and measure scalability, architectural, and other design issues, in addition to allowing far more flexibility when changes are required.

Local school administrators and teachers have been included in the discussions on this program, and one of the things learned from the pilot projects is that technology directors are key to the success of the project; fortunately, there are some excellent technology directors in Indiana schools. The project design takes into consideration the facts that staffing is limited and that local funding sources are strained - both for materials and for staff. However, while there is no substitute for a good teacher and quality interaction with students, equipping teachers with modern tools will help them to maximize their talent and capability to touch each and every student.

Mike Huffman is the
Special Assistant for Technology
Indiana Department of Education

Policy Perspectives

THE EDUCATIONAL IMPACTS OF THE LACK OF ACCESS TO HOME COMPUTERS

Robert W. Fairlie

The latest estimates from the Computer and Internet Use Supplements to the Current Population Survey (CPS), conducted by U.S. Bureau of Labor Statistics and U.S. Census Bureau, indicate that the digital divide is large and does not appear to be disappearing soon. Blacks and Latinos are much less likely to have access to computers, the Internet, and broadband at home than are white, non-Latinos. The digital divide also appears to be larger for children than for adults.

The educational impacts of the digital divide appear to be significant. In previous research, I find evidence suggesting that home computers increase school enrollment, high school graduation, and grades (Fairlie, 2005; Beltran, Das & Fairlie, 2005). I also find evidence that home computers decrease school suspension and criminal activities. Home computers may exert a positive influence on academic performance directly through the use of educational software and indirectly by facilitating the completion of school assignments and learning. The use of home computers may also open doors to learning, encourage some teenagers to stay in school, reduce truancy and crime, and offer economic incentives for completing high school.

In the first article (Fairlie, 2005), I use data from the Computer and Internet Use Supplement to the 2001 Current Population Survey to explore whether access to home computers increases the likelihood of school enrollment among teenagers who have not graduated from high school. A comparison of school enrollment rates reveals that 95.2 percent of children who have home computers are enrolled in school, whereas only 85.4 percent of children who do not have home computers are enrolled in school. Controlling for family income, parental education, parental occupation, and other observable characteristics, I continue to find a difference in school enrollment rates of 1.4 percentage points. Using additional statistical techniques that try to control for family differences in educational motivation, I find a difference of school enrollment rates of 7.7 percentage points. These estimates suggest that home computers increase the likelihood that children stay in school.

In the second article, Beltan, Das, and Fairlie (2005) use data from the two main U.S. datasets that include recent information on computer ownership among children—the 2000-2003 CPS Computer and Internet Use Supplements (CIUS) matched to the CPS Basic Monthly Files and the National Longitudinal Survey of Youth 1997—to explore the relationship between computer ownership and high school graduation and other educational outcomes. Teenagers who have access to home computers are 6 to 8 percentage points more likely to graduate from high school than teenagers who do not have home computers, after controlling for individual, parental, and family characteristics. It is important to control for these characteristics because children who live in families with home computers are wealthier, have more educated parents, and have other "advantaged" characteristics.

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We also find evidence of similarly strong relationships between home computers and educational outcomes using several estimation strategies and even after controlling for detailed home environment and extracurricular activities. Home computers appear to increase high school graduation partly by reducing non-productive activities, such as school suspension and crime, among children.

Overall, the results of these two studies and others from the literature provide evidence that access to home computers improves educational outcomes among children. These findings have important policy implications. They suggest that disparities in access to technology are likely to translate into future disparities in educational and economic outcomes, thus making the low rates of access to home computers among disadvantaged minorities and poor children especially alarming. Policies that address the financial, informational, and technical constraints limiting the optimal level of investment in personal computers among disadvantaged families may be needed. The numerous and increasingly popular state and local programs that provide laptop computers to schoolchildren represent one solution. Tax breaks or special loans for educational computer purchases, training programs, and computer donations represent a few additional examples. The findings also raise concerns about funding cuts for technology-related programs affecting disadvantaged groups, such as community technology centers (Servon, 2002). Finally, home computers in the educational process may become more important over time as schools are increasingly digitizing content and there is growing momentum for the controversial issue of replacing textbooks with CD ROMs or Internet-based materials.[a]

[a] One of the action steps included in the new U.S. Department of Education's (2004) National Education Technology Plan is to "move away from reliance on textbooks to the use of multimedia or online information (digital content)."

RECOMMENDATIONS

The Report on the Effectiveness of Technology in Schools by the Software & Information Industry Association claims that "education technology is neither inherently effective nor inherently ineffective; instead, its degree of effectiveness depends upon the congruence among the goals of instruction, characteristics of the learners, design of the software, and educator training and decision-making, among other factors." [64]

Despite the need for more evidence that educational technology can promote academic achievement, the research studies and best practices cited in this policy brief support the Association's statement. If the utilization of technology does not adequately match the goals of instruction, its use cannot be expected to support increased academic achievement. Likewise, if teachers and other educational personnel are not trained to optimally use the technology available to them for instruction, technology cannot serve its purpose. Is educational technology in Indiana worth the investment? Obviously, yes. Indiana must continue to strive to prepare its students to meet the educational and workplace demands of the 21st century they are inheriting. The following recommendations can assist the state with fulfilling its responsibility to its citizens:

1. Similar to the reading program in Canton, Ohio (highlighted on page 3), the Indiana Department of Education and school corporations throughout the state must continue efforts to align classroom curriculum with the use of educational technology. Furthermore, assessments of the technological competence of Indiana students should be developed so that students can demonstrate knowledge of how to use the technological resources available to them.

2. Given the ongoing budget and economic concerns facing both the state of Indiana and the nation, the challenge of long-term reduced state and federal funding for educational technology must be met with innovative strategies to address the needs of our schools. Educators and policymakers should utilize whatever funds are available to focus on providing comprehensive teacher training, matching technology with the curriculum, offering more technology support, and, as Hess suggests, strategically using integrated data systems so that schools and teachers can maintain and maximize the technology already in place.

3. As funds become available, and to augment one-to-one computing in schools, the Indiana Department of Education should provide school corporations with the flexibility under the Technology Plan Grant Program to use desktop workstations or laptop computers. States such as Maine have found that providing home wireless networking and take-home laptops to students, who would otherwise be without access to them due to economic hardship, can increase student performance.

4. The Indiana Virtual Education System (IVES) should be implemented so that technology-based learning opportunities can be coordinated statewide. Proposed in the 2001 IDOE legislative agenda, IVES would offer students AP and a variety of other courses online, provide on-demand professional development to educators, and enable school corporations to share limited resources.[65]

5. Since many higher education institutions increasingly utilize a variety of technology tools, high school seniors continuing on to higher education should be knowledgeable of these tools so they will not fall behind their peers due to a lack of technological savvy. To help ensure high school graduates are "tech-ready," the state should require the completion of an online course for high school seniors much like the state of Michigan requires of its high school students.

6. To increase the utilization of online testing and improve the turnaround time on test scores, the Indiana Department of Education should conduct an assessment inventory of local computer, wiring, and connectivity capabilities to determine the technology infrastructure needed to best implement such testing. IDOE should report the outcomes of this inventory to the governor, legislature, and State Board of Education so that the state can develop a strategic plan with funding to implement online statewide standardized testing.

7. Although Indiana's training standards for teachers and school administrators require that technology be embedded in the training curricula, the state does not currently require testing to measure technology competency for either initial or recertification of teachers, except for teachers desiring a license to teach computer education. Indiana should require the assessment of teachers' educational technology skills, especially of those instructors teaching online courses.

8. In order to determine cost-effectiveness, expected educational outcomes must be clearly defined. Should educational technology be deemed academically effective only by an increase in standardized test scores that can be directly related to technology's use in the classroom, or are intermediate objectives such as increasing student engagement sufficient to warrant the use of technology? A direct association between technology and academic achievement should not be the only consideration for educators. Rather, what students demonstrate they can do with technology apart from strict academic applications should be taken into consideration.

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WEB RESOURCES

Buddy^2 related Web sites
www.buddyproject.org
www.thewritingsite.org
www.btlc.org

Consortium for School Networking Ed Tech Resources:
www.cosn.org/resources/emerging_technologies/learningspaces.cfm

Indiana E-Learning Academy
www.inelearning.org

Indiana Department of Education,
www.doe.state.in.us/technology/

Inspire
www.inspire.net

National Education Technology Plan Programs
www.nationaledtechplan.org/

NetDay Speak Up Day For Students 2004
www.netday.org/speakup_forstudents_2004.htm#Visions

Net Literacy Corporation
www.netliteracy.org

Project Home Town Indiana
www.wvec.k12.in.us/hometown/

The SBC Fellows Program at Indiana University
sbcf.iu.edu/about/goodpract/

Ubiquitous Computing Education Consortium
www.ubiqcomputing.org/

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