Intellectual Property and the Educational Laptops: A case from Texas and Puerto Rico

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Texas Laptops Abstract

The computer revolution has placed pressure on public educators to provide students with up to date technology intensive instruction. During the late 20th century, the Texas State Legislature responded with two initiatives. First, they proposed replacing print with electronic textbooks. Second, they studied the feasibility of putting a laptop computer into the hands of every public school student by having them lease these computers at ten dollars a month for a period of three years. In this case we look at the results of several pilot programs the legislature funded to test the feasibility of their initiatives. We also look at other, related projects, technology integration projects into Silicon Valley public schools and a project in Puerto Rico that provided every public school teacher (who wanted it) with a free laptop computer. Along the way, we examine intellectual property issues, safety, equity & access, and privacy as well as the impact of computing technology on teaching and learning in public schools.

Socio-technical System

	Hardware & Software	Physical Surround-ings	People, Roles, CIDS	Procedures	Laws & Regulations	Data & Data Structures
Descrip-tion	*Hardware*: Laptop Computers Peripherals Internet supports (wires, modems, wireless antennas) *Software:* Windows on Science, , NetLibrary, etc *Internet* e2e layered architecture	Wired, student centered classrooms	Students	Adopting and Purchasing Textbooks (TBE and Public Hearing)	Texas Legislature procedures	Print and Electronic Texts
			Teachers		Definition of Textbook	Content delivery by software
		Wired, teacher centered classrooms		Fund Raising Options for ISDs	Equal Access Laws including Edgewood Case	
			Local Educational Institutions	Technical and Training Support for Faculty	Intellectual Property Laws, especially copyright	
		Unwired student centered classrooms		Setting up the Pilot Program Study (Proposal Call Selecting Vendors Selecting Textbook Providers Contracting Assessment Experts)	Bill Passing Procedures	Storing media including floppy disks, hard drives, CDs, & jump drives
		Unwired, teacher centered classrooms	State & Federal Educational Institutions			
			Textbooks Providers			
			Computer Vendors	Texas Public School Funding Procedures		
			Independent Educational Assessment Groups			

Socio-technical System

Hardware

Hardware includes laptop computers. For example, the Texas Board of Education considered having students lease Apple, Apple iBooks, and Compaq laptops. The physical characteristics of laptops—their size, weight, and durability—weigh heavily since they must take over many of the functions formerly carried out by print textbooks. For example, students of all ages need to be able to move them to different locations within the classroom and take them home to do homework. Durability is especially important. For computers to substitute effectively for printed textbooks, they would have to last roughly the same amount of time: three years with the possibility of low cost upgrades to extend this lifecycle.

Computer peripherals such as printers, printer cartridges, CD drives, DVD drives, floppy disk drives, USB ports, and storage media (floppy disks, hard drives, jump drives, and CDs) all fall under the category of hardware. Digital display projectors would play an important role in allowing teachers to present material and students to share their work with the class. Digital display projectors would also make it possible to broadcast video material played on laptops with DVD playing capacity.

Laptop batteries constitute important hardware for several reasons. They make computers more portable. Their reliability and lifecycle are important factors in laptop portability and usefulness. Batteries also contain hazardous chemicals. Designing safer batteries that last longer, present less danger of exposing children to toxic chemicals, and are more easily recycled would greatly enhance the usefulness of laptops.

Finally, laptops give us access to the Internet. Hence hardware would also cover devices associated with the Internet and access to the Internet. Modems, LAN connections, wireless cards and antenna fall under this category. Also, the hardware underlying the architecture of the Internet, the wires over which the information passes, routers, servers, and other features become a part of the socio-technical system. Internet accessibility, for example, provides a means for frequent updates of electronic textbooks; this would circumvent the problem of obsolescence that plagues the current textbooks used in Texas public schools.(reference)

Software

Software plays an important role in this case. Texas claims to be the first public school system to adopt an electronic textbook, *Windows on Science*. Other educational software packages mentioned in this case are *Knowledge Adventure*, *World View*, and *Net Library*. A key issue concerns the characteristics of software-based electronic media and its ability to deliver educational content to students. (See Huff and ? for information on how educational software can embody gender bias.)

Software/code also supports the Internet; this would include Internet browsers, encryption methods, uniform document formating such as html and pdf, software that facilitates building web sites (Front Page for example), and the software support for email.

Software has played a key issue in the ability of teachers to integrate computers into the classroom. Many of the pilot projects were hindered by the lack of appropriate software for delivering course content to students. One reason for this is that textbook

publishers give software development a low priority. They treat software, not as a stand alone support to teaching, but as a supplement to printed material. Since software development follows the completion of printed material, less time and expertise has been invested in its development. Moreover, teachers have not played a significant role in the development of the very software they are expected to employ in their teaching. This places upon teachers a difficult dilemma. Either they must use existing software, no matter its limitations. This requires that they change their teaching philosophy and method to that embodied in the software available. Or they must refuse to use available software in the classroom and be blamed for standing in the way of progress as well as impeding the teaching of computer literacy. A third issue associated with software is the amount of attention given in the design and implementation stages to user (teacher and student) training and technical support. Finally, how does educational software in reality compare with printed media on its effectiveness in delivering course content to students? How do we identify the content/curriculum to be delivered? How do we effectively assess the ability of different media (print and electronic) to deliver this content?

Finally, we have already mentioned the importance of the hardware components of the Internet. The software that forms its architectures also turns out to be important. First, the architecture of the Internet is not value free. Second, it is not established but is evolving in certain direction. For example, our choices regarding encryption devices to be used has profound long term implications as to whether the Internet will be a free or highly controlled domain. The rapidly evolving legal interpretations of intellectual property will also determine whether the Internet will continue to be an intellectual commons that houses the collaborative development of ideas and property or a highly controlled domain compartmentalized into areas of property the access to which is largely restricted. Moving to the case at hand, the Internet provides public school students with vast stores of information as well as new possibilities for interaction between people. Does the software exist that allows us to screen student access without overly restricting the availability of useful information? The capacity of the Internet for bringing people together, for allowing one-many and many-many modes of communication, for making available vast amounts of information, and for allowing students with new modes of expression provides both educational opportunities and dangerous challenges and risks. Software development will play a large role in the future in responding to these opportunities, challenges, and risks.

Physical Surroundings

Does the physical layout of the classroom determine the philosophy and method of teaching or does the philosophy and method of teaching dictate the physical layout of the classroom? Perhaps, because this is yet another version of the question, "Which came first, the chicken or the egg?" it is better to hold that the physical layout of the classroom and the style of teaching and learning that goes on within it are co-determinate, each influencing and influenced by the other. With this in mind, we can correlate teaching philosophies, classroom arrangement and degree of classroom "wiredness" by the following table:

Technological Integration/ Learning Strategy	**Not Wired (classroom is technology free)**	**Wired (technology fully integrated into classroom)**

Teacher Centered	1. Not-wired, teacher centered classroom (Traditional Model)	2. Wired, teacher centered (Technology supports traditional teaching)
Student Centered	3. Not-wired, student centered classroom (Classroom modified for active student learning)	4. Wired, student centered (Technology supports individualized student learning)

1. *Not-wired, teacher centered classroom.* This traditional classroom room is divided into a teacher zone (large desk, blackboard, chair, etc) facing a student zone (rows of smaller, individual desks where students sit with their books, papers, pencils, and pens). At any rate, the distinction between the teaching and learning functions is sharply drawn and reinforced by a clear physical separation of the teaching zone and the learning zone. Traditional, teacher centered activity includes presenting, lecturing, and asking students content-focused questions.
2. *Not-wired, student centered classroom.* This classroom has the same materials as the traditional classroom but these are arranged differently to support a distinct teaching philosophy and method. Desks form a circle or rectangle at which students and teachers sit together to hold discussions. Or the desks are grouped to form small work stations where active or cooperative learning take place. The distinction between teaching and learning has diminished or disappeared. This is reflected in the merging of the teaching and learning zones. Teachers often sit with students when holding a discussion. The classroom is decentralized from the teaching zone and reorganized around work stations, discussion groups, and learning activities.
3. *Wired, teacher centered classroom.* This classroom resembles the traditional classroom in that it reinforces the teaching-learning distinction with the physical separation of teaching and learning zones. The main difference between this classroom and the traditional one is the presence of technical supports for the teaching activity. The teacher still dominates the front of the classroom. Desks and blackboards provide stations from which the traditional activities of presenting, lecturing, and questions take place. However, these traditional teaching activities are now supported by computers and computer peripherals; desktop computer with monitor, PowerPoint presentation software, printers, screens, electronic blackboards, and data display projectors. The teacher center may be electronically connected with a remotely located library allowing the library to broadcast video materials into the classroom. Student work stations or even student desks may be equipped with computers. However, teaching and learning are distinct roles allocated to teachers and students respectively. The classroom arrangement, including the computing technology present in the room, reinforces these distinct roles.
4. *Wired, student centered classroom.* Technology is fully integrated with student centered learning. For example, students might sit at desks arranged in a rectangle. The teacher occupies one side while the students sit at the other sides in swivel chairs. Behind the students are learning stations with computers and peripherals. Students move freely from the discussion area to the surrounding computer stations. For example, a small group of students may decide that an idea that has arisen in the class discussion merits further exploration. They detach from the main discussion group and conduct an Internet search. Later, depending on the results, they could move back to the main discussion and report on what they have learned in their Internet

search. Learning is student centered and the distinction between student and teacher is diminished or eliminated. Computing technology supports a variety of student learning activities including discussion (bulletin boards), questioning (students send the teacher and other students emails), and electronically delivered course content. The Internet and Internet searches play an important role in learning.

People and Roles

The following table shows the primary stakeholders in this case, namely, the people, their stakes and roles, the organizations to which they belong, and the problems or conflicts that could arise between them:

Texas Laptop Stakeholders

People or Groups	Roles	Stakes (Interests, rights, goods, or values in play)	Conflicts
Public School Students	Learning (Learning and Teaching in cooperative learning)	Future Civic Participation Finding and holding jobs	Students are required to lease laptops yet are unable to afford leasing costs
Public School Teachers	Teaching (Teaching and coaching in cooperative learning)	Teaching positions Professional dignity Academic Freedom Professional autonomy	Teachers are forced to integrate computers and blamed for negative results
Local Education Administration	Administering ISDs and responding to parental and student concerns	Jobs (elected positions) Community respect and support Faculty & student respect and support	Local Educational Administrations are forced to make hard financial choices when pressed to purchase computers without being provided the necessary funds
State & Federal Educational Institutions	Setting national and regional educational goals and standards. Implementing standardized achievement tests. Coordinating local educational districts around national goals and standards.	Jobs as well as reputation of the political administrations whose policies they implement. Implementing initiatives such as Bush's "No Child Left Behind"	State & Federal Educational Institutions suffer political pressure to integrate computing technology and produce computer literate students. At the same time, they are under pressure to reduce spending on education.
Computer Vendors	Providing computers and computer peripherals to schools Providing technical and training support	Livelihood Financial gain	Vendors are expected to donate equipment & provide technical support and training at low or no cost.
Print Publishers	Providing public schools with up to date textbooks that reflect standards and deliver curriculum content	Livelihood Protection of intellectual property rights	Print publishers are asked to convert print to electronic texts. Yet this may adversely affect their ability to control

			and profit from their intellectual property.
Independent Educational Assessors	Study and evaluate the effectiveness of pilot programs for integrating technology	Reputation Autonomy	Assessors find data unfavorable to pilot programs and must resist pressure from stakeholders to suppress it.

1. *Students*. Students occupy a central place in the Texas Laptop case. They stand to benefit in the form of access to more information, more adaptable and updatable textbooks, and better, technology-enhanced education. But many students will be unable to affording the leasing fee. Moreover, there are conflicting accounts of the impact of technology on education. Many argue that technology will profoundly change the way we educate and that this change may not be for the better. (Are we not replacing education with "infotainment"?)
2. *Teachers*. Teachers also play an important role in this case and stand to benefit or lose in major ways. The primary instrument for integrating laptops into Texas classrooms are public school teachers. But many lack technical expertise or even basic competence. Can training programs be economically developed to bring them up to a minimum level of competence? Others find computing hardware and software incompatible with their teaching philosophies and methods. Does forcing them to integrate technology into their teaching violate their autonomy as well as their academic freedom? Finally, those who do want to integrate computing technology into their teaching find formidable obstacles standing in their way: existing educational software does not effectively deliver curriculum content and necessary technical support is rarely available. Teachers will not receive credit if computing technology is successfully integrated into the classroom. However, they will be blamed if this integration proves difficult or impossible. (Cuban)
3. *Local Educational Institutions*. The administrations of the Independent School Districts (IDSs) of Texas stand in the middle of several, possibly conflicting groups and individuals. Parents hold these institutions responsible both for what is taught and for how successfully it is taught. The IDSs will also be on the receiving end of parents who are angry over leasing fees or are unable to pay them. Finally, the IDSs are responsible for funding the integration of computing technology into the classroom. Vendors are reluctant to donate equipment and technical support; they eventually expect to profit from this venture. (Interestingly enough, technical support constitutes the major expense associated with integrating computers, running as much as three times the original purchase price of the equipment.) Do these school districts raise revenue for computer purchases through increased taxes, soliciting Federal and state grant funds, or taking revenue from other budget items? The Texas State Legislature is banking on saving money from textbook purchases and by passing on technology expenses to the parents. Should these fail, the IDSs will stand on the receiving end of the blame coming from state and federal education institutions as well as the general public.
4. *State and Federal Educational Institutions*. "No Child Left Behind," a well known Bush administration education program, sets standards for local school districts and

punishes those who fail to meet these standards. The Texas State Legislature sets standards (and develops the educational initiatives to carry them out) at the State level. On both the Federal and State positions, there is strong pressure to integrate computers into the classroom and to graduate computer literate students. But many critics assert that the funds supporting these demands are not forthcoming from the agencies that impose them. Texas, for example, does not have a state income tax. It supports education through property taxes and a state sales tax. Historically, it has suffered from a wide disparity in education funding between rich and poor school districts. Studies and Blue Ribbon panels have made several recommendations for improving education. For example, in the early 1980's, H. Ross Perot headed a commission that recommended more equitable funding for Texas public school districts as well as the controversial "no pass, no play" provision where schools that failed to meet minimum standards were forced to shut down their football programs. Federal and state educational institutions make demands of local districts. What are their responsibilities for providing the means to carry these out?

5. *Textbook Publishers*. In 1989, the Texas State Legislature expanded the definition of "textbook" to include electronic media. Then they became the first state to adopt an electronic textbook, *Windows On Science*. The potential impact of these two acts on textbook publishers is profound.
    - First, these publishers get much of their revenue from the states that purchase their textbooks. Any decision made by the state of Texas on this issue stands to have huge impact on their business and finances.
    - Second, because they periodically renew and update their textbooks, publishers gain much of their revenue from public schools discarding obsolete texts and purchasing new texts or new editions. The Texas leasing program was designed, in part, to eliminate the need to repurchasing print textbooks by developing a system of online updates for the electronic textbooks. Consequently, print publishers could argue that the Texas Laptop Plan does not so much reduce educational costs as redistribute them, taking money away from textbook providers and transferring it to computer vendors who provide computing equipment, peripherals, training, and technical support.
    - Third, textbook publishers have a great deal to lose from the conversion of print to electronic texts. The ease with which electronic media are copied and distributed makes it difficult to employ traditional copyright restrictions and protections. They stand to lose more money than ever from copyright infringements and violations.
    - Finally, textbook publishers find themselves confronted with a difficult, long term choice. Should they continue working in printed media or shift to electronic media? Since their expertise lies with printed media, shifting toward electronic texts would entail considerable investment, shifting of expertise and talent, and substantial risk. Publishers of print textbooks have to decide whether the field has a viable future or whether print textbooks are the buggy whips of the book world.
6. *Computer Vendors*. Computer vendors were expected to donate considerable equipment and software, as well as technical and training support to the Texas Laptop pilot programs. Some did but also made it clear that this support was limited. Computer vendors stand to gain considerably from the vast expenditures required to

integrate computing technology into public schools. But they also must respond to requests to donate equipment, technical staff, and training expertise to support the pilot studies and these expenditures are not without risk. What responsibilities do the vendors have in this context? What responsibilities do the school districts have? If vendors donate equipment, time, and expertise to the pilot studies, does this guarantee a lock in of future equipment purchases? Can they trust the state of Texas to honor their donations with future contracts? Finally, how do vendors develop effective technical and training support programs and maintain the staff to implement these?

7. *Independent Educational Assessment Groups*. MGT and T.H.E. were hired to help set up the pilot studies. They were assigned the task of assessing the effectiveness of these different integration projects and helping Texas identify and select "best practices" in computer-intensive education. Conflicts could arise if the assessment data does not support the overall emphasis on computer integration. How do assessment groups go about reporting negative data on the desirability, impact, and feasibility of integrating computers into the classroom? Interested stakeholders (vendors, software developers, the Texas Legislature, and the general public) could exert considerable pressure to suppress negative results and to overemphasize the positive. Because of the close client relation, these groups could face considerable challenge in maintaining their integrity and in carrying out independent, balanced, and objective evaluations.

Procedures

Four procedures stand out in the Texas Laptop case: adopting and purchasing textbooks, fund raising procedures for ISDs, developing effective programs for faculty training and technical support, setting up the pilot studies (including selecting the ISDs for the specific projects.

1. *Adopting and purchasing textbooks*. The Texas Board of Education selects the textbooks to be used in public schools. They purchase new books every six years for some four million students. Textbooks cost around 1.8 billion for their six year use cycle or 300 million per year. The process of choosing textbooks includes extensive public hearings where members of the community comment on individual texts and their content. The TBE is targeted by interest groups looking to influence public education through textbook content. Since Texas administers one of the largest public school populations in the nation, the TBE (thorough its textbook purchases) stands to exercise a great deal of influence on their content and format. Moreover, since this represents a major public school expenditure, it is also the target of legislators interested in cutting education spending. One of the motives behind the Texas Laptop plan was to save some 300 million dollars per year by circumventing the need to buy textbooks. Electronic textbooks can be more easily updated and renewed. Internet access places students in direct contact with free and easily accessible information. Electronic textbooks also offer possibilities to the state of Texas for solving intractable equity & access problems. In 1987, the Federal court found the state guilty in a case involving inequitable funding of school districts and ordered them to provide adequate funds for poor districts to match those of wealthier districts. Since Texas does not have a state income tax, their only means for raising

revenue for education is through increases in property and sales taxes both publicly unpopular measures. The money that the laptop plan would supposedly save could go to the poorer school districts and thus partially redress some of the funding imbalances. Moreover, students who suffer from various disabilities would benefit from electronic textbooks. Blind students could take advantage of electronic textbooks with audio text; deaf students could benefit from the enhanced visual capacities of such texts. One of the initial motives behind expanding the definition of textbook to include electronic texts was to respond better to the challenges presented by students with special needs.

2. *Procedures available to school districts for raising funds*. Increasing revenue through tax increases has become increasingly unpopular and difficult. In a recent federal study, different fund raising methods are identified and evaluated. Local school districts could fund technology acquisition by floating bonds. They can also take advantage of federal and state programs that provide grants for specific technology integration projects. Computer vendors (including software providers like Microsoft and hardware manufacturers like Dell) have also donated equipment, expertise, and support. Careful study reveals that IDSs could put together packages that bundle different fund raising strategies to raise the necessary funds for purchasing equipment and securing technical support.
3. *Working with computer vendors to develop and implement effective faculty training and support programs*. Early reports from the Texas pilot projects indicate that while most faculty are interested in making use of computing equipment in their classes, many are unable to do so because of lack of appropriate software, insufficient training and competency in computer use, and lack of effect technical support. Concerning the last problem, lack of technical support, the costs sometimes run as high as three times the initial costs of purchasing equipment. Vendors play a crucial role in resolving these problems. Yet they have their own conflict to resolve: while they have responsibilities to the schools to help with the integration of computers, they also have to compete and generate profits. Resolving this vendor conflict while responding to the concerns of the school districts to find effective and cheap ways to integrate computers into the classroom, will require careful, detailed, and good faith negotiations between vendors and educators.
4. *Setting up the pilot studies (including selecting specific projects from the ISDs)*. The Texas State Legislature provided the broad outlines of the Laptop Plan and mandated a series of pilot studies to test its feasibility. But responsibility for carrying this out fell on the TBE (technology division). The studies called for identifying and negotiating with computing vendors, setting up a call for proposal for pilot studies, and selecting an independent group to assess the results of the pilot studies. Of special interest here is the process whereby the TBE established the proposal selection criterion that formed the basis of its selection of ISDs for the pilot studies. MGT and T.H.E. helped in the selection of these criteria and in the selection of the projects to be funded. Among the criteria were that the studies collective represent a broad range of students, school districts, student populations, and that it studied schools with a diversity of experiences working with computing technology.

Laws & Regulations

1. *The Legislative Process*. In this case more than perhaps the others we have presented in this book, the procedure whereby public opinion is refined and shaped through the legislative process, converted into law, implemented in the real world, and assessed in terms of its value and effectiveness plays the key role. The public desire to integrate technology into the education of their children has manifested itself in several ways. First, there is the anxiety over what many perceive as the declining competitiveness of the United States in the world economy. Producing a computer literate workforce would seem an effective response and reverse this undesirable trend. Second, computing technology holds forth several promising possibilities for enhancing the effectiveness of the educational experience. Software programs provide feedback and teaching to students for more individual attention. Internet access provides a direct route to unlimited stores of information. Electronic textbooks appear to retain the useful qualities of printed media while advancing upon these by providing the possibility of frequent and easy updates, a multi-media format, and features that respond to the special needs of students. Moreover, computing technology in general promises more speed and more efficiency which translates into long term savings in educational costs. In short, the public wants computers in the classroom because they respond to public anxiety about American competitiveness, promise to enhance the educational experience, and offer future reductions in educational costs. The legislative problem facing the Texas legislature is how to translate these public perceptions into effective law.

In this case the Texas Legislature has translated public perception into law through a series of bills. These include Texas State Legislature revises definition of textbook to include electronic textbooks. Initial motive—equal access to students with disabilities. (Digitalizing media for disabled students), 74th Legislature forms advisory task force to compare print and electronic textbooks, Senate Bill 1, House Bill 2128, & House Bill 85: Integration of technology into education, and Senate Bill 294: (Commissioner of education appoints advisory committee to determine costs of using computer networks, including Internet, in public schools. Through these legislative acts, Texas has focused public opinion into a series of public school pilot projects designed to study the feasibility of the Laptop Plan and to identify a series of best practices to be duplicated in other school districts.

2. Expanding the definition of textbook to include electronic textbooks. In 1989, the Texas Legislature viewed electronic textbooks as the solution to several problems. First, they felt that electronic media, because of its multi-facetedness, promised to give students with special challenges equal access to educational material. This is more than just a semantic change. By expanding the definition of textbook to include electronic media and combining this new definition with its substantial purchasing power, the state of Texas is in the position to redefine the way curriculum content is delivered to students. The TBE decides which textbooks its students will use. Since there are four million public school students, this decision translates into considerable power over textbook providers in determining the content and form that these textbooks will take.

Consequently, Texas brought about real world consequences for its semantic change by adopting the first electronic text into its school curriculum, *Windows on Science*.

3. In 1967, the Edgewood school district brought a suit against the state of Texas for drastically under-funding their activities in relation to other school districts. This case, which lasted for twenty years, led to guilty verdict issued by a Federal Court. In 1987, the Court mandated that Texas take measures to bring equality to the funding and quality of its different independent school districts. This translates into a mandate to guarantee that the different school districts receive equal funding in the area of educational technology, that is, that not-wired schools be brought to parity with wired schools. Finding revenue for technology purchases has not proven easy, especially since Texas lacks a state income tax, a revenue source for public schools in other states. Raising property taxes and state sales taxes, besides being political suicide for Texas elected officials, also raises its own problems of equity by shifting the burden of public education on consumers and property owners. This revenue problem, exacerbated by this history of unequal school district funding, has driven the legislature toward the Laptop Plan as a cost effective way to integrate computing technology into the classroom. The leasing plan promises to save money by allowing for more frequent updates, thus reducing new textbook purchases. But it also shifts the burden of funding technology acquisitions on those who stand most to benefit, namely, the students themselves and their parents. This recreates the equity and access problem at the student level as those who can afford the leases are pitted against those who cannot.

3. Intellectual Property Laws. Intellectual Property issues loom large in this case as print textbook publishers, textbook authors, public school districts, and public school students vie over access to the textbooks that deliver educational content. Textbook publishers are interested in controlling access, profiting from, and protecting the IP embodied in their books. The school districts and students are interested in loosening this control and in creating more flexible media through which educational content is delivered. A special issue arising in the Laptop case concerns the ownership of information entered into laptop computers by students and teachers. Suppose teachers enter original exercises and materials into their computers. Who has copyrights over this material? The same issue arises with students who store information and material on laptop hard drives? Who owns the material? Who is responsible for real world consequences that issue from this material?

The following represents a partial list of the IP ethical and legal trail:

1. **Copyright Law.** Basic point: don't expect this to be the same in two years.
2. Copyright law history (1790, 1909, 1976, 1980, 1984, 1998). An accelerating pace of change in copyright law. 1909 change was brought about because of technology too: the player piano. Changes from 1976 on are primarily to address software issues.
3. **Sonny Bono Copyright Term Extension Act (SBCTEA, or Mickey Mouse Law, 1998).** Extended the term for copyright protection from life plus 50 to life plus 70. Done just in time to save Mickey Mouse from becoming public domain. Caused problems with some public domain works of literature on the web becoming proprietary again.
4. **Digital Millennium Copyright Act (DMCA, 1998).** Significant piece of legislation to implement WIPO (see below) agreements. A controversial portion is the anti-

circumvention clause that (with NET, see below) makes it illegal to circumvent protection technology or to distribute or link to information on how to do so (with intent to circumvent). This bumps up against the values of both free speech and of fair use.

5. **Fair Use.** Portions of copyrighted objects can be for specific purposes, such as criticism and scholarship.
6. **First Sale**. Once you purchase a copyrighted item, you are free to do what you will with that copy. Can you give away licensed software? Resell it?
7. **Uniform Computer Information Transactions Act (UCITA).** Covered in product liability intermediate concepts. Here it is relevant because it establishes licensing (and shrink & click-wrap licenses) as the standard for software sales, while reducing liability for the product.
8. **No Electronic Theft Act (NET, 1997).** Removes the requirement from earlier copyright law that making a copy must be done "willfully and for purposes of commercial or financial gain" in order to be illegal. Now it just has to be more than $1,000.
9. **DeCSS and Circumvention in DMCA.** The *Universal Studios vs. Reimerdes* case in which DeCSS, a program to decrypt DVDs (originally for Linux) was posted to a web site and links to other sites with the software were also established. Court ruled for Universal to suppress the software posting. This case has caused significant concern about free speech issues. There is concern that linking now can be an illegal activity. Proponents say this concern is inflated, and that the language banning linking to sites with illegal items is narrow enough and focused on intent to circumvent. Currently under appeal.
10. **Sony vs Universal (1984).** Universal Studios sued Sony, the company providing BETAMAX video recording technology, because it could be used to illegally duplicate copyrighted material. The court ruled that the technology could not be restricted simply because it might be used to do something illegal, as long as the technology was capable of substantial legal use.

Data and Data Structures

Data, data structure, and data storage compose the final feature of the Texas Laptop STS. Data first of all includes educational content which can be delivered by print media, electronic media, or through the Internet. A key issue in this case is which kind of media best delivers this content, print or electronic. Moreover, another issue concerns the data stored on the Internet. Many educators distinguish between information and knowledge. The Internet provides students with ready access to vast stores of information. But, as Larry Cuban puts it, the educational process is largely how to impart to students the ability to convert this information into knowledge. Such skills include the ability to select and evaluate the information available. Moreover it includes the ability to critically examine this information and to recognize the vast differences between the quality of information available.

Finally, data and data structure raise the issue of data storage. Traditionally data has been stored in print media. Now computer media offer all kinds of alternatives including hard drives, floppy disks, CDs, and jump drives. The last media, jump drives, raises a whole series of problems and possibilities because of the portability and utility it provides along with its vast storage capacity.

Texas Laptop—Historical Narrative

The Political Backdrop

In this historical narrative, we want to discuss four aspects of the case: the political/social background, the details of the plan itself, the legislative initiatives that structured it, and the pilot projects carried out along with their results.

The political background begins with the Edgewood case. In 1967, the Edgewood school district sued Texas for inadequate and inequitable funding. The lawsuit was drawn out for twenty years and ended when the Federal Court ordered Texas to redress inequalities in funding for public education in 1987. In particular, the court told Texas to eliminate the striking differences between the rich and poor districts.

Texas, in general, had been known as one of the worst providers for public education during the 60's, 70's and much of the 80's. Political pundits joked that the raison d'etre of the state of Mississippi was to prevent Texas from being ranked last in its support of various public initiatives, including education.

During the 1980's, this situation began to change as Texas reevaluated the importance of public education. Well business leader and presidential candidate, H. Ross Perot, headed a commission to study the state of education in Texas during the early 1980's. Perot's commission found education under-funded and in poor shape. They argued that poorly educated students translated into a substandard workforce which would undermine the competitiveness of Texas business. They also passed the notorious and controversial no pass/no play provision. Texas school systems that failed to meet minimum education standards (as measured by the Texas state-wide proficiency exam) would lose their football programs. Football—it was felt—provided the only incentive strong enough to force Texans to recognize the importance of public education and raise school standards.

Texas's problems in funding public education are grounded in the state's tax structure. Many states have four methods available to raise funds for education: property tax, state sales tax, and income tax. Texas has no state income tax. This means that increased funding for public schools must come from increasing property or sales tax, tantamount to political suicide for elected officials in Texas. To address inequalities in state funding, Texas politicians had to look to reapportioning existing funds rather than generating new funds. Then governor Ann Richards proposed such a strategy in the Robin Hood Plan she introduced in 1993. The bills' proposal to taking funds from rich school districts and redistribute them to the poor ones proved controversial. The initiative barely passed the Texas legislature and was resoundingly defeated by voters in a referendum.

This political backdrop sets the stage for the Texas Laptop case. First, equity and access to computing technology forms a central part of the general issue of equal funding for Texas schools. While wealthy school districts were able to integrate computing technology into their curriculum, the poorer schools and their students stood on the other

side of the digital divide. Addressing inequalities in school funding entailed developing a plan to reduce the digital divide between those students who had access to computers and those who did not. Second, Texas's tax structure limited the options available for acquiring new technology for schools. Increasing school funds through tax increases proved impossible. Education officials began to look for ways to spend existing funds more effectively and efficiently. This entailed cost cutting. In short, the political background places the Texas Laptop case in the midst of a fundamental confict. On the one hand, Texas educational officials found themselves under strong public pressure to increase spending on technology, particularly computing technology. The public demanded computer literate graduates who compete in the wired world-wide economy. On the other hand, the public's instinctive hatred of raising taxes limited the means for acquiring this new technology. The solution, addressed specifically by the Texas Laptop Plan, was to reapportion existing funds. The Texas Laptop Plan purports to fund technology integration by shifting the financial burden to students, computer vendors, and textbook publishers. Students would lease their laptop computers to the tune of ten dollars a month for three years; computer vendors would donate computing equipment and technical support to public schools; and textbook publishers would forgo profits from selling new textbooks and new editions to existing textbooks by providing public schools with electronic textbooks that could be updated via online downloads. The Texas Laptop Plan promised a utopian solution to the dilemmas facing Texas educators: a technologically enriched school environment with no new taxes.

The Texas Laptop Plan

In May 1998, then Texas State Board of Education chairman, Jack Christie, presented the Texas Laptop Plan to members of the Texas State Legislature as well as representatives of the press. This activity, reported in the New York Times on May 20, 1998, provided spectators with quite a show. Computer vendors gave demonstrations of the durability of laptops by, among other things, spilling water on them and claiming that they could support 250 pounds. Christie's high profile presentation promised to respond to three enduring problems in Texas public school education: the inequality in school funding now telescoped into the digital divide between wealthy poor students, an effective response to public pressure to graduate computer literate workers, and the demand to do all of this without raising taxes.

The TLP, first of all, promised to put a laptop computer in the hands of every public school student in Texas. Part of Christie's presentation consisted of showing that laptop computers were sufficiently developed to perform successfully a number of educational tasks. Second, the money for this would come from the students themselves through a leasing plan, through computer vendor donations, and through savings in textbook purchases. Each student would lease his or her computer for 10 dollars a month for three years (500 dollars). Computer vendors would, as a public service, donate equipment and technical support. Finally, Texas would replace printed textbooks with electronic textbooks that could be delivered through the laptop computers. Converting print into electronic textbooks would save on printing costs, shipping and handling, paper costs, and the expenses associated with updating. (Print textbooks could be updated only through expensive new books or new editions. Texas purchased new textbooks every six

years, spending 1.8 billion dollars, an average of 300 million a year. Electronic textbooks could be updated quickly, frequently, and cheaply through online downloads at the publisher's web sites. Moreover, frequent online updates would circumvent the problem of out of date textbooks which was inevitable given the six year purchase cycle.) Combining the revenue from laptop leases, computer vendor donations, and savings with electronic textbooks, the Plan's proponents expected to cover all the costs of providing roughly four million public school students with their very own laptops.

Plan supporters cited several advantages to this plan. First, laptops provided the means of developing and exploiting the considerable advantages of electronic over printed textbooks. Electronic textbooks could be developed to respond to special student needs, for example, providing audio text for the blind and enhanced visual text for the deaf. In short, electronic texts offered ways of reducing disparities existing between challenged students and the rest of the student population. Moreover, electronic texts could store considerably more information, be connected with information sources in the Internet through hyperlinks, and provide more interactive educational possibilities. A second advantage consists of making education more responsive to the "wired" generation. Many school children have grown up using computers, playing video games, sending emails, and surfing the Information Highway. Laptop computers would provide content delivery options that would appeal to these wired students who were bored by traditional teaching methods. Third, the Laptop Plan would solve the problem of the digital divide. Every student would have a laptop; no student would be left behind in the march toward computer literacy. Moreover, because laptops are portable, every student would have a computer *at home* for homework, word processing, preparing presentations, and conducting online research. (Wireless Internet hookups, connected to the local school network via wireless antennas, would allow even poor students to go online at home for little or no expense.) Fourth, special, interactive educational software delivered through laptop computers would provide students with individualized instruction and thus facilitate self-teaching. Teachers would find their task considerably simplified with the help of the laptops and supporting software. This would free them to give students more individualized attention. In short, proponents came to see the Laptop Plan as a panacea, a solution to all their problems.

However, opposition began to develop, almost from the start. Those who opposed the laptop plan initially formulated three objections. First, they pointed to hidden costs that made the Laptop Plan less economically attractive than it first appeared. Print publishers were unlikely to give up control over textbook content when such control furnished them with considerable revenue. The cost savings from converting to electronic textbooks were more apparent than real. Second, the Laptop Plan was not as equitable as it first appeared. Many students would be unable to afford the lease. The plan would place upon them and their parents an unfair burden. Finally, opponents took exception to the claim that computers could effectively deliver curriculum content to "wired" students. Throwing out traditional educational methods and skills and replacing them with showy video-game formats threatened to convert education into edu-tainment.

As time passed, opponents were able to point out that the Laptop Plan carried with it an unproven educational philosophy. For example, teachers were not participating in the design of computer formats and educational software development. Yet these media embodied value through the choices of the designers. Integrating computers and software into the classroom without teacher consent or participation could violate the autonomy and academic freedom of public school teachers. Opponents argued that this was at the bottom of teacher resistance to computer integration. Second, teacher training and technical support brought forth hidden problems and costs that made the Laptop Initiative less attractive than it seemed at first appearance. Technical support costs turned out to run roughly three times initial acquisition costs. Initial training programs proved ineffective. Many teachers found them too basic to be of help while others found them too advanced. Inadequate teacher training and lack of technical support proved substantial obstacles to technology integration programs. Third, opponents argued that computers delivered information, not knowledge. Access to the Internet certainly put students in contact with vast stores of information. But students needed the skills to evaluate this information, group it into meaningful categories, and approach it with critical thinking skills. Computer-delivered information provided no support for developing these crucial skills and probably distracted students from their acquisition. Finally, educators attacked the philosophical basis of the Laptop plan, the idea that the primary purpose of public schools was to prepare students for the workplace. Larry Cuban argues that this economic motive must not supplant the other essential functions of public education, those of creating the social capital necessary to build thriving social communities and that of equipping students with the skills necessary for civic engagement and participation in a democracy. If students were turned away from engaging one another and their teacher in the classroom, if their dominant educational experience turned out to be interaction with a machine, then the development of the social skills necessary for community and democratic participation would be neglected and atrophy. We might have better workers (although even this was doubtful) but we would be stuck with worse neighbors and citizens. Computer-enhanced, computer-dominated education threatens to narrow and impoverish the scope and function of a public education.

Legislative Initiatives

The Texas Laptop Initiative grows out of the ambivalent attitude the public has toward computers. On the one hand, they find computers fascinating, attractive, and capable of bringing about many good things. Computers are technological marvels that have transformed our lives and have made all sorts of things possible. On the other hand, the public fears computers because they do not completely understand them. These two attitudes have combined in the form of a concerted public effort to integrate computers into public school systems in order that their children will understand them and be able to function effectively in a world that is increasingly computer dominated. The Texas Laptop case provides fascinating insight into how public attitude is shaped through the legislative process and focused into public policy and public action. It also shows the danger of such a process. Those who stand to feel the greatest impact are those at the endpoint of this process, the teachers and students. Neither has participated to the extent to which he or she will be influenced.

Teachers stand to be influenced because, as we said above, computing technology and software is value laden. Value decisions made in the course of the design process become embodied in the final product. In particular, we will see that educational software embodies and facilitates a certain philosophy and method of education. Becker argues that computer-driven educational programs promote student self-teaching and cooperative learning. He points out that opponents of integrating computers into schools, like Larry Cuban, hold fast to traditional, teacher-centered educational philosophies. But the point here is not to find out which educational philosophy is better, the teacher-centered approach or the student-centered approach; both have their strengths and weakness as well as specific domains in which they function well. Rather, the issue is whether a particular approach to teaching should be imposed on public school teachers and students in the guise of introducing computing technology into the classroom. Here the issue is clearer: teachers and students, since they are to live with the consequences, must have some say and be able to participate more fully in the design of computers and educational software.

Students stand to be influence also by this process, and, perhaps, they are in the worst position to influence the outcome. If integrating computers into education will have a great influence on the philosophy and method of that education, how sure are we that this influence will be for the good? Moreover, many of today's students have grown up in a world in which computers are pervasive. Certainly computers and software are effective vehicles for delivering large quantities of raw information. But they are also filters. So we need to think carefully about the nature of these filters and focus on what they leave out as well as what they allow in and of the specific structures they use to shape the information we view. In particular, do media that deliver information through video game formats or flashy visual and audio effects threaten to convert education into edu-tainment? Finally, we need to reiterate what was said just above, that educational software embodies value. Huff and ? found that software designed to teach grammar embodied gender bias. (See Chapter 1) Rushing into the computerization of the classroom causes us to both embed such value into the electronic media we are designing and at the same time to pass over its significance. Thus, from the student point of view, the shaping of the public demand to computerize the classroom and the form it has taken in the TLP requires that we pause and look carefully at its impact on student learning. What values are we imposing on the learning value? Do we, as a political, moral, and social community affirm these values?

With this caveat in mind, we turn to looking at the legislative initiatives that have translated the public's desire to integrate computing into concrete classroom initiatives. The following represent distinct legislative actions oriented toward integrating computing technology into public schools:

1. As we saw above, the legislative background begins with the mandate to correct inequities in state funding of public education brought out in the Edgewood decision of 1987. State responses include a commission to study public education in Texas

(headed by H. Ross Perot) and various funding measures such as the unsuccessful Robin Hood measure introduced in 1993.

2. In 1989, Texas took on the issue of technology in education by expanding the definition to textbook to include electronic textbooks. The definition expanded "textbook" to include "any means of conveying information to the student or otherwise contributing to the learning process through electronic means." (SB294) The significance of this move lies in the fact that the Texas Board of Education decides upon the textbooks to be used in public schools and then purchases them in six year cycles. The total cost runs around 1.8 billion dollars or 300 million a year. This sum forms a substantial part of the revenues of several major textbook providers, so Texas exercises considerable influence on the content and form of textbooks nationwide. If Texas decides to substitute electronic for printed texts, then the effects will ripple throughout the rest of the nation.
3. Continuing along these lines in 1991, Texas required for its schools, *Windows on Science*, a videodisc-based program that became the first state-adopted electronic textbook in the nation. Other electronic textbooks used by Texas public schools included *NetLibrary, Knowledge Adventure*, and *World View*. Public schools also made extensive use of word processors to teach writing and mathematics software to carry out drill exercises.
4. In 1992 Texas asked three educational companies to develop computer literacy programs for public schools. Texas then used these programs to develop a year-long course in computer literacy to be taken by all seventh and eighth graders. This formally integrated the demand for computer literacy into the classroom.
5. In 1995, the 74th Texas Legislature passed three bills (Senate Bill 1, House Bill 2128, and House Bill 85) that mandated and structured state planning for educational uses of technology. Senate Bill 1 included two components: a request that the State Board of Education develop a plan to integrate technology into school curriculum and a mandate for the Texas Education Agency to investigate ways to develop electronic textbooks accessible to *all* students.
6. In 1997, the Texas Legislature passed Senate Bill 294 Senate Bill-294 that required the commissioner of education to appoint an advisory committee to determine the costs and benefits of using computer networks, including the Internet, in the public schools. In this same bill, the Commissioner was also ordered to investigate supplementing textbooks through computer networks.
7. In 1999, the Texas State Legislature authorized the Texas Education Agency (TEA) to design and carry out educational technology pilot programs. Among these were several designed to test the laptop initiative. Thirteen Texas school districts were selected for study. Since these investigations required expert educational assessment, MGT and THE were hired to help structure the studies and to interpret their results. During this time, the TEA also lined up computer vendors willing to donate equipment and expert training staff to the school districts under study. The result was a major study that began in January 2000 and concluded two years later in December 2001.
8. On December 1, 2000 the commissioner of education submitted an interim report on pilot projects that included the following:
    - The methodology used in collecting information

- Individual reports from pilot sites
- An evaluative summary of the first year of the pilot programs prepared by MGT and THE
- A discussion of lessons learned as well as an attempt to identify educational best practices, i.e., computer-intensive programs that were successful and could be implemented elsewhere
- Recommendations for the future

Conclusion (to date)

The TLP has not been fully implemented. Hidden costs, teacher concerns, and competing technology integration projects have all slowed down its implementation. But it is by no means dead. Recently 7000 laptop computers were given to Texas students in a public school district. The state of Maine has recently implemented an ambitions program to give its students laptops. Larry Cuban recently studied technology integration programs in public schools in the heart of computer land, Silicon Valley, California. Finally, Puerto Rico carried out a program (with dubious results) in which laptops were given to all public school teachers who requested them. In short, there is still a push to integrate computing technology, educational software, electronic textbooks, and other computer peripherals into the classroom.

The Texas project produced some success and some challenges, and we will conclude with these.

Successes:

- The pilot studies showed clearly that teacher computer use increased. Teachers found computers valuable for carrying out administrative tasks, for giving class presentations, and for carrying out Internet searches to prepare for teaching.
- Limited, successful integration of computers into the classroom was also achieved. Computers were used effectively in mathematics classes where drill work is an essential component of teaching strategy. They also provided considerable help in writing classes where they helped students and teachers focus on the writing process rather than writing mechanics such as grammar and spelling. Computers were also successfully used in business oriented classes.
- Students in the pilot programs increased computer use at home using computers for such activities as doing homework, conducting Internet searches, and playing education-oriented games.
- Finally, the pilot projects showed successes in encouraging students and teachers to use the Internet for research projects.

Challenges

Several challenges impeded the integration of computers into the classroom and into the public school curriculum. These included the following:

- The pilot programs were plagued by difficulties in finding vendors who were willing to donate equipment and—more importantly—technical support. Many vendors backed out on commitments to provide equipment or were late in doing so. Others

were slow in providing technical support during the start up phases of the pilot projects and failed to provide timely support when failures occurred.

- Teacher training proved to be a crucial element to successful computer integration. It also proved difficult and costly to provide effective faculty training programs. Those who were already working with computers found the training programs too elementary while those who were confronted for the first time with computers found them too difficult and advanced. Time also emerged as a serious problem. School administrators were reluctant to allow teachers spaces in the regular schedule to devote to computer training while teachers were understandably reluctant to donate their free time for this. A key to successful training programs turned out to be administrative leadership and support.
- Lack of technical support turned out to be a major impediment to computer integration. Technical support costs have proven three times those of initial equipment outlays. Vendors were reluctant and late in providing technical support. Often, students who had worked considerably with computers were drafted as "computer experts" and were relied upon to troubleshoot. The pilot programs showed the importance—the crucial importance—of reliable technical support. They also verified its considerable expense.
- Perhaps the most significant challenge came from the teachers themselves. They resisted changing their style and philosophy of teaching. As we noted above, computers and educational software embody value including values that promote some educational approaches at the expense of others. Consequently, some teacher resistance can be attributed to the legitimate motive of remaining true to their educational philosophies and experience. Other obstacles came from inflexible schedules that imposed on teachers hard choices; if they included computer-intensive instruction, then they had to exclude something else. Many teachers were reluctant to make these trade offs without further examination. Cuban emphasizes that the danger here is the teachers who resist the integration of computers into their classes be accused of being anti-technological or blamed for impeding necessary progress. Teacher opposition to computer intensive education could be founded in legitimate differences in teaching philosophy, experience, and method. It must not be dismissed out of hand as anti-progress.

Time Line

Date	Event
1961-2000	Internet emerges as a repository of information and an intellectual commons. Begins to support research and commerce.
1971-2000	Developments in the design and manufacture of computers make it feasible to equip students with laptops. (Cost and durability reach level where integration becomes possible.)
1968-1987	Edgewood Decision. Federal court orders Texas to redress inequities in funding between rich and poor school districts. The digital divide emerges as one of the inequities.
1984	Texas Legislature, in HB 72, begins to implement reform package recommended by Perot Commission. Equitable financing is emphasized. Arguments for enhancing school tied to the need to provide state businesses with an educated, modernized workforce. Controversial no pass/no play provision ties football programs to schools meeting academic standards.
1989	Texas State Legislature revises definition of textbook to include electronic textbooks. Electronic textbooks introduced to address needs of special students but also proposed as an eventual replacement of printed textbooks.
1993	Robin Hood bill introduced by then governor Ann Richards. Basic strategy is to redistribute money from rich to poor school districts. Measure passes Texas Legislature but is defeated by voters in a ballot referendum.
Early 1990's	Texas becomes first state to adopt an electronic textbook, *Windows on Science*.
1995	74th Legislature forms advisory task force to compare print and electronic textbooks
1995	Senate Bill 1, House Bill 2128, & House Bill 85 address the integration of technology into education
1995	Senate Bill 294 orders the commissioner of education to appoint an advisory committee to determine costs of using computer networks, including Internet, in public schools.
March 1999	Texas Education Agency (TEA) is authorized to conduct educational technology pilot programs.
May 1999	Chairman of the Texas State Board of Education, Jack Christie, presented the Texas Laptop Plan to members of the Texas State Legislature as well as representatives of the press.
1999	Texas Education Agency, together with private education firms MGT and THE, sets up pilot programs. Vendors are selected to donate computing equipment and provide technical support to pilot schools. Pilot schools selected on basis of proposals they submit.
January 2000	TEA Pilot Programs begin
December 2000	Pilot programs submit interim progress reports. MGT/THE carry out preliminary assessment including onsite visits to pilot schools. TEA submits preliminary report to the Texas State Legislature.
2001	Larry Cuban studies the integration of computers into public schools in Silicon Valley, California. He recommends proceeding cautiously because of impact on student education and expense.
2001	Second half of pilot studies carried out. TEA submits final report to Texas Legislature, December 2001.
2002	Texas Laptop Plan updated. More study recommended along with setting aside the idea of leasing computers. Other funding options are studied. (Folder 1: US DOEd)
2004	Technology in Education announces that Texas Technology Immersion Project has distributed 7000 laptops to public school students. Project funded by a 12 million dollar federal Title II grant from the US Federal government.

Texas Laptops: Education for the 21st Century

The Texas public schools system fully upgrades textbooks every 6 years. Toward the end of this cycle, teachers and students find themselves saddled with outdated material. For example, in the fall of 1997 Texas schoolchildren learned that the Berlin Wall was still standing and that Ronald Reagan was president. They did not find information in their books about more recent events such as the AIDS epidemic. Ensuring more frequent updates without burdening the state's budget led the Texas Board of Education (TBE) to consider new options. (Citation)

Their answer was to replace the printed public textbooks with durable, low-cost laptop computers. The $1.8 billion already budgeted for textbooks over the next six years could be redirected toward purchasing laptops. Initially, the TBE projected that this plan would save nearly $300 million annually with the additional benefit of guaranteeing public school students up to date material.

Much of this saving would be brought about by shifting the costs from the state to the students' parents. Parents would have to lease laptop computers for their children at a $10 a month reaching a total of $500.

The plan is a further advancement of bringing technology into education, which can be traced back as far back as 1989 in Texas. Since the 71st Texas Legislature expanded the definition of "textbook" to include electronic media, there have been four bills passed that affect state planning for educational uses of technology. In addition to requiring students to complete a year-long computer literacy course in the seventh or eighth grade, electronic educational programs continue to be adopted in subject areas such as chemistry, geography, Science I and II, and economics.

The use of computer diskettes, CD-ROM, laserdisc, distance learning via satellite, and the Internet are all sources from which students will be able to garner the most pertinent and up-to-date information surrounding an issue.

The Texas Board of Education believed that increased access to electronic media through laptops will engage students and spur them to higher levels of achievement. It will help teachers to be open to students and to collaborate better with them. Because of the rapid development of computing technology, they hope that electronic textbooks will help students develop technology savvy and become more effective employees as they enter the working world.

Texas Laptops

Texas has a reputation for being a leader in the use of technology for educational purposes. This push for educational technology began when 71st State Legislature expanded the definition of "textbook" to include electronic media. It continued when Texas became the first state in the nation to adopt a technology-based textbook, *Windows on Science*. Due to the enormous amount of students in its public schools (almost 4

million), Texas has had a major influence on the textbook industry for many years. Faced with a $6 billion plan to replace K-12 textbooks over six years, the chairman of the State Board of Education, Jack Christie, developed an idea where each student would be given a low-cost, upgradable laptop computer which would serve as their textbook for all subjects.

The 74th Legislature created an advisory board and assigned them to compare and contrast print textbooks and electronic textbooks in terms of classroom impact. The committee reported that although both print and electronic textbooks share the same formatting and design elements (text, text formatting, symbolic text, graphics, and navigation system), these elements could be greatly enhanced if presented electronically. Additional advantages of electronically presented content include hyperlinks, expand and collapse features, search features, sound, fixed sequence animation and movies, interactive elements (i.e. a four-stroke engine where the student is able to turn the flywheel on the engine), live information, collaborative environments, and three-dimensional environments.

In March 1999, the Texas Education Agency (TEA) announced that it would conduct pilot programs to study the laptop initiative in a representative group of Texas school districts. These two year studies were carried out in 2000 and 2001. Preliminary reports have identified several needs:

- providing equitable access to computing technology for all students including those with special challenges
- investing in the professional development and continued training of teachers to help them integrate computing technology into their teaching
- establishing and financing technical support for those teachers who choose to integrate computing technology into their classes
- developing software that delivers substantial usable content as electronic media replace traditional print media

A Brief History of Texas Laptops

The idea of providing highly sophisticated educational tools for all students is not a new concept in Texas. As the textbook is the primary vehicle through which students receive their education in addition to their instructor, Texas has continually expanded the properties of textbooks so that all students are encouraged to grow socially and intellectually.

In 1985, a year after the first Macintosh computer came out, the State Board of Education of Texas implemented a long-range plan for acquiring and using technology in the public school system. It was the board's responsibility to encourage professional development in the use of technology for educators and other individuals associated with child development. The board was also charged by statute to further students' computer literacy so that each high school graduate has computer-related skills that meet the standards adopted by the board.

In an attempt to stay abreast with the rapid social changes brought by the advent of widespread computer usage, the 71st Texas legislature expanded the definition of "textbook" to include electronic media. The education code also included a definition of an electronic textbook as "any means (s) of conveying information to the student or otherwise contributing to the learning process through electronic means" (SB 294 Introduced version – Bill Analysis11Nov00).

In 1991, Windows on Science, a videodisc-based program, became the first state-adopted electronic textbook in the nation. The following year three educational companies developed three computer literacy programs which Texas then adopted in its required year long course devoted to the subject which students could either complete during their seventh or eighth grade years.

The process of technology becoming more prominent in education was again reinforced when, in 1995, the 74th Texas Legislature passed three bills (Senate Bill 1, House Bill 2128, and House Bill 85) that affected state planning for educational uses of technology. Senate Bill 1 guided the State Board of Education to develop a plan for schools to obtain and use technology in their curriculum. Rooted in Senate Bill 1 was a directive that the Texas Education Agency investigate the possible ways to develop electronic textbooks that are accessible to *all* students, including students who are blind or who have visual impairment.

In 1997, the 75th Texas Legislature passed Senate Bill-294, which required the commissioner of education to appoint an advisory committee to discern the costs and benefits of using computer networks, including the Internet, in the public schools. Also to be included in the study project was the possibility of delivering updated supplements to textbooks through computer networks. Presiding officers of the Senate and the House of Representatives were also to appoint two members of the legislature to serve on the advisory committee.

Taking precautions so that the study used a geographically, demographically, and economically balanced sample was of paramount importance to the committee because the results would have statewide applications and so that all students, who Texas claims would have equal access to technology should the plan attain legislative approval, would be represented.

41 Texas School Districts were selected based on their participation in the Texas Library Connection, applications for Technology Integration in Education (TIE) grants, nomination by members of the Advisory Committee, self-nomination, and geographic diversity. These 41 districts were exceedingly diverse by size, student composition, geographically, economically, technologically, and Texas Assessment of Academic Skills (TAAS) passing rates.

11 of the 41 school districts were chosen for in-depth case studies through two-hour video conferences. Schools were selected to reflect…

- variations in geographic location (for example, urban, suburban, and rural sites
- representative sizes
- different student composition
- a representative percent of economically disadvantaged students
- different TAAS passing rates
- different degrees of technology infrastructure
- varying staff technology skills

Issues such as technology infrastructure, technology support and staff development strategies, use of technology by administrators, teachers, and students, use of electronic instructional materials, impact of technology on education, and the impact that technology has on instruction, student performance, and administration.

With many state-adopted textbooks including electronic components, the logical next step would be to move to stand-alone electronic educational products such as laptop computers. Or is it? This was exactly the question raised when, in May 1998, the chairman of the Texas State Board of Education presented a plan to the state legislature whose premise was to replace public school textbooks with durable, low-cost laptop computers. Instead of the state purchasing textbooks for students, the responsibility would require parents to lease a laptop computer for every child. The total lease cost would be $500 with a monthly lease fee of $10. Students would receive curriculum materials on CD-ROMS, computer diskettes, or through the Internet.

As was presented Therac-25 case, the idea to replace printed textbooks with electronic textbooks was built from a multitude of earlier components of thought in regard to education and technology

Opposition to Texas Laptops

Although there has been much support for Texas laptops, there are also those who oppose such a massive endeavor. One issue that arises in this debate is security and loss prevention. This is a two sided notion in that the security of both the student and the laptop may be jeopardized. Students carrying laptops may be seen differently than students carrying printed textbooks and thus may be more likely to be placed in an unsafe situation such as being robbed. Is a student's safety worth him/her having advanced technology in the classroom?

Another question that has arisen is whether or not the laptops parents lease for their children will become obsolete. In an age where technological advances are so rapid, it would be almost impossible for schools to keep up with such changes. Although information upgrades may be available, will students actually be at a disadvantage from having to work on such out-dated machinery? If Texas Laptops emphasizes the importance of producing tech-savvy employees, it must remember that that includes creating a system where students will also have equal access to the most up-to-date

hardware and software. Without that element, students will be receiving fresh information from an obsolete source.

Educational Technology Providing Increased Learning Opportunities for Texas Students (Ed Tech PILOTS)

In 1999, the 76th Legislature authorized the Texas Education Agency (TEA) to conduct educational technology pilot programs, including a laptop initiative, during 2000-2001. A group of 13 representative Texas school districts selected for the pilot programs utilized various technologies and content vendors with the underlying goal of delivering curriculum and increase student learning.

On December 1, 2000, the commissioner of education submitted an interim report to the governor, lieutenant governor, speaker of the house of representatives, and the members of the 77th Legislature, describing the methodology used in collecting information, pilot sites, an evaluation summary of the first year of the pilot programs, lessons learned, and recommendations for the future.

Methodology

In response to the legislative directive to implement the pilots, TEA realized the enormous size of the educational endeavor and found it necessary to maintain a consulting firm that would help and advise them in creating and implementing the pilot programs. A Request for Proposals (RFP) was submitted and the following criteria were required for selected contractors:

- Design the standard to be met by vendors selected to provide technology services
- Assist the agency in developing cost guidelines for the pilots
- Assist the agency in selecting the pilot sites
- Incorporate the standard into a request for proposals
- Evaluate proposals and provide a recommendation to the agency
- Collaborate with vendors/publishers/developers interested in delivering content to pilot sites
- Provide pilot oversight, including coordinating of maintenance and repair
- Provide evaluation services (formative, summative) related to the pilot programs to include monitoring and reporting student performance in all technology pilot sites
- Assist in writing year-end reports with recommendations for future action, including cost estimates

TEA also chose four technology areas in which to conduct the pilot programs:

- Laptop computers
- Enhanced video distance learning
- Internet access
- Other innovative technologies

MGT of America, Inc. (MGT) was hired as the primary contractor for the pilot programs and T. H. E. Institute and Publishers Resource Group were selected to serve as the subcontractors to MGT.

TEA and MGT also developed a procedure for selecting pilot sites and implementing the pilot programs. Involved in this process was obtaining educational resource contributions from vendors, qualifying the contributing vendors, soliciting school district participation that would incorporate educational technology products contributed by the qualified vendors, evaluate and select school districts that provide a wide variety of technology approaches.
TEA and MGT concluded from a large meeting with over 160 individuals from over 120 companies that the best way to garner the educational resources needed for the pilot programs from these companies was to produce a Request for Statement of Interest (RFSOI). Under this action, companies would donate their resources (i.e. hardware, software, professional development, and on-going support) to TEA at no cost. Having seemingly gathered the resources they would need for such a widespread educational venture, TEA then began to issue a Request for Application (RFA) from school districts who desired to acquire some of these technology resources to conduct a pilot program in which the district's educational needs would be addressed. TEA's assumption that vendors would be able to donate their valuable resources to the school districts at no cost over an extended period of time proved to be a weak point in the program methodology. A survey of the vendors showed that two out of three (63%) could not afford to provide the cost of training and support for the duration of the project. Over half of the vendors (54%) also shared they would not be able to supply the schools with their products at no cost.

Although the original intent was to conduct 25 pilot programs, the lack of vendors able to donate their products at no cost resulted in a substantial reduction in the number of pilots. Sufficient resources were obtained so that 13 pilot programs could be completed. Recognizing their limitations, TEA/MGT decided to monitor similar pilot programs other organizations were conducting in an effort to acquire additional data relevant to the delivery of educational content through technology. Pilots being conducted in Taylor Independent School District (ISD), Ysleta ISD, the Texas School for the Blind, and the Texas School of the Deaf would be monitored.

MGT used a variety of methods for assessing the progress and outcomes of the pilots. They used pilot surveys of students, teachers, and principals, assessments of quarterly progress reports submitted by the pilots, observations during site visits to pilot sites, and collection and analysis of relevant student and teacher performance data before, during, and after the pilots had been conducted.

Pilot Sites

9 (2 elementary, 3 middle school, and 4 high school) of the 13 pilot sites selected for the study were Laptop computer pilots.

Vivian Middle School, which is part of Carrollton-Farmers Branch ISD, is concentrating on providing textbook materials, interactive software, and supplemental software in mathematics for students in the sixth grade using the laptop computers already owned by the school. MGT visited the school on May 22, 2000 to observe classroom activity and interview teachers about the progress of the project. Teachers reported that the new electronic math lessons had too many "skill level" activities and too few "application-based" activities. They also pointed out that the change from a traditional classroom setting to a technology-rich classroom atmosphere was extremely stressful for teachers and administrative staff. However, teachers said that the anxiety eventually subsided. MGT also observed that students showed high levels of excitement and active participation with the computer-assisted learning. Staff expressed their satisfaction with their content vendor (Glencoe/McGraw Hill) and reported that parents are extremely supportive of the project. This is not surprising, however, seeing that parents purchased laptop computers for the project.

Hillsboro Jr. High in Hillsboro ISD has developed a pilot program entitled LAPLink (Laptops and People Linked) where students will be able to check out laptops and use the school's remote system to access the Internet and other technology sources from their homes. Hillsboro ISD and EarthWalk Communications, Inc. will be working in partnership to provide laptops for the students. Students will be able to attend summer computer camps, will have the capability for creating a more individualized method of learning for themselves using software provided by Knowledge Adventure, and will present portfolio projects and perform student-led community-based technology training. MGT visited the school on March 31, 2000 to observe the installation of the wireless laptop computer network and instructional software. The installation went smoothly and the students were able to begin using the laptops. Students showed extreme excitement about the new operating features of the laptops and later worked through a PowerPoint presentation with their teacher.

Lake Worth High School of Lake Worth ISD is currently implementing a pilot program where they have placed laptop computers into the hands of all tenth grade students (advanced placement students are the target group in this school). The laptops will be used in English and history classes. WorldView will provide materials to be used for history and NetLibrary will be used to provide materials English. Apple Computer will furnish the laptops and staff development for teachers. MGT visited this pilot site on April 18-19, 2000 and found that the school had just received its laptops (Apple iBooks). Teachers were observed being trained in how to use the notebook computers both for themselves and for their advanced placement students. Teachers reported that they were exited about the potential for using these notebook computers that required no hard wire connections to access the Internet and a local file server. Additional software was to arrive before the end of the 1999-2000 year.

Although Taylor ISD and Yselta ISD are not involved in the legislative pilots, they have strikingly similar goals and methodologies for delivering educational content via technology. In fact, each respective district implemented pilot programs that involved

providing laptops to students on a much larger scale than any of the 13 TEA pilots. *Taylor High School* in Taylor ISD received grants that enabled every freshman and sophomore to receive a laptop that could either be used at school or taken home to be used by the student and his/her family. Ninth and tenth grade teachers were also provided with their own laptops and received professional development in its use. *Rio Bravo Middle School* of Ysleta ISD contracted with NetSchools, Inc. to provide students in grades six, seven, and eight with a laptop. Students could use the laptops at school and at home and were able to communicate with the school and the Internet after regular school hours. Teachers received extensive training and staff development in how to incorporate computers and technology into the classroom. Follow-up data provided by independent researchers shows that, from the analysis of the Teacher Questionnaire, the following conclusions were found:

- Teachers used laptops daily to create lesson plans, develop homework assignments, do research, and for instructional delivery
- A majority of students were using laptops two to three time a week to access the Internet for research, complete homework assignments, prepare presentations, take class notes, and write papers.
- Teachers believed the laptops assisted student in every core subject are. They stated that laptops helped the most in English/language arts and science classes.
- Fifty-eight percent of teachers indicated the project had "very much" of a positive impact on student achievement.

The following conclusions were found from analyzing data found from the Student Questionnaire:

- Overall increase of 59% in student use of computer both at school and at home. Student use of computers at school before the project was 16%; after the project student use was 77%. Eleven percent of students used computers at home before the pilot program; after the project student use increased to 56%
- A majority of students reported they used laptops to access the Internet, complete homework assignments, take notes, write reports, and complete electronic assignments.
- A majority of students also reported that they used their laptops in every subject area at least two or three times per week.
- Fifty-one percent of students believe that as a result of using the laptop in middle school, their grades in high school would be better, and 82% reported that the laptop program had made a difference in their academic achievement.

Impressive gains were found when researchers compared the results of the 1998-1999 TAAS scores against the baseline scores from 1997-1998. Math scores increased 7.7 percent, and writing scores increased 11.7 percent.

Evaluation

MGT examined the progress notes each of the 13 pilot programs had submitted to TEA. These records summarized what the pilots had accomplished or had been challenged by during the months of March through August 2000.

Accomplishments reported by more than one pilot

Eleven (84%) of the pilots included a receipt of hardware or software from vendors and reported that initial training of teachers to use the new technologies had been accomplished during this time. 7 (53%) pilots stated that they had begun using some or all of their new technologies in the teaching of students and that they were mostly on target with the goal they had stated in their grant applications. 3 pilots notes that they had produced evaluation instruments or surveys to assess their projects' progress. 2 (15%) of the pilots also reported that they had had successful parent orientation sessions.

Accomplishments reported by no more than one pilot

- Implementing a system for checking out laptop computers for students' use at home
- Drafting new lessons
- Finalizing vendor agreements
- Selecting a lead teacher for the project
- Holding weekly meetings of the project team
- Making a presentation about the project at a state conference
- Establishing a project web site
- Improving the quality of instruction due to extended planning among team members
- Having students create and publish multimedia presentations using the new software
- Improving the technology skills of all project team members

Challenges reported by more than one pilot

12 (93%) of the sites stated that they had received their Notice of Grant Award (NOGA) later than they had expected, which led to later starts to the pilot programs than they had originally proposed. 3 (23%) pilots reported delays in receiving the hardware and/or software for their projects. The same number of the pilots experienced difficulty in providing baseline data for the students and teachers, especially at the end of the year. And 2 (15%) pilots said that they had had equipment failures and/or need for repairs and that teachers' schedules were already full and that as a result teacher technology training sessions were difficult to schedule. 2 (15%) of the pilots also said that they had lost key personnel that they had planned to involve in the pilot program. It was also shown in all 13 pilots that, although most of the pilot programs had become fully operational at the beginning of the 2000-2001 school year, students had minimal opportunity to use the new technology resources during the 1999-2000 school year.

Challenges reported by no more than one pilot

Although there were a wide variety of challenges reported, there were several points that are particularly germane to the issue of providing laptops to every student. Included in these challenges are overcoming initial staff resistance to participate in the project, experiencing difficulties with lack of access to electronic textbooks, being delayed by district policies that prevented students from taking the project's notebook computers home for use after teachers already had created homework lessons, having to use a substitute for the planned on-line curriculum because the Internet service provider had technical difficulties and could not provide service to the school at times, spending much time developing (through trial and error) a check-in/out system for students to use laptop

computers at home, tracking equipment issued to students, and obtaining technical support for teachers and/or students.

Conclusion

The report shows that the Ed Tech PILOTS are in the early stages of their development and that it would be premature to draw conclusions based on such early observations. Based on the interim report, there is not substantial material that fully validates the use of laptops. Although the executive summary does indicate that although there continues to be widespread enthusiasm for the pilots, there are major factors inhibiting their successful implementation. The executive committee has identified three major components that need to be further investigated in order to accomplish their educational goals: equitable access to the technology itself, investment in professional development and technical support, and substantial usable electronic content.

Equitable access to technology

Idealistically, *all* teachers and students should have computer access at home and at school. 88% of teachers report that they have computer access at school but fewer than half report having computer access at school. 38% of students report not having computer access at home and a further 13% report that they have access but do not use their computers to do homework at home. It is clear that purchasing laptops for every student will be costly. New and challenging technologies may help to lessen these costs. Handheld machines can also deliver a substantial amount at a significantly lower cost.

Professional Development

Teachers who are trained and have full technology support are four times as likely to be an effective technology-using teacher than a teacher who receives minimal support and no training. However, the cost of providing a teacher with professional training and technology support costs four times the amount of the computer's cost. The positive side to professional development is that the technology equipment will be used to its fullest extent in educating students.

Delivery of substantial content

Many of the vendors believed that they felt that public schools were not ready to receive the core content of their print textbooks electronically.

What is the process of replacing printed textbooks with electronic textbooks?

The procedure for carrying out the largest educational venture in Texas State history is a complex process. In addition to obtaining legislative approval to systematically replace all printed textbooks with laptop computers, the Texas Board of Education has to provide more than inspirational predictions as to whether or not the plan will succeed.

Legislative Approval

The first step in the process of Texas replacing all printed textbooks with electronic textbooks is to obtain Legislative approval. Unfortunately, the plan has yet to receive this

support. However, there has been such widespread interest in the plan that the Legislature has approved a bill that requires the Texas Education Agency (TEA) to develop a study to investigate the use of computer networks in public schools, including the use of such networks to deliver updated supplements to school textbooks.

Locating Vendors

The next step is locating hardware and educational software vendors who would be willing to supply various Texas school districts with the resources they require in providing its 3.9 million students with quality education. There has been much debate as to how and if Textbook publishers will be willing to give away the material on which they thrive free online, on computer diskettes, or in the form of CD-ROMS. Critics also pose the notion that the recent widespread enthusiasm for laptops is corporate driven and will fizzle within a few years. Supporters for Texas laptops, including the chairman of the State Board of Education, disagree with these fears about corporate interests saying that Texas has the purchasing power to ensure that the state receives its money's worth from hardware and software companies. Given the $1.8 billion budgeted for textbooks over the next six years and its corporate-like influence in the textbook industry, the Texas Board of Education may indeed have the power to ensure the quality of education it demands.

One major question facing the Board is how to provide a laptop computer that best facilitates students. This includes but is not limited to a laptop that contains word-processing software, a graphic calculator, and a modem card for a Net connection. The main issue in this discussion is how to supply students a laptop that is highly durable. Given the age and level of activity of each student, the ability of a laptop to function after being dropped or experiencing other wear and tear damages is a pertinent issue. Although he would not give the name of the company, the chairman of the board described how the board had seen a computer that could be dropped from three feet and stood on by a 250-pound man without incurring any damage. There has yet to be a vendor who has publicly stepped forward and shown such durability in its products.

Costs

The next step involved in moving to laptops is determining monetary costs to publishers, school districts, taxpayers, parents, and students. Costs were one of the main positive incentives for the Texas laptops plan. It is estimated that the plan would save the state approximately $300 million each year. This is not without a caveat. Instead of purchasing textbooks, the state would require parents to lease a laptop for each of their children attending public school. The total cost of the lease would be $500 and the monthly lease fee would be $10 per child. This could present problems to families who are economically disadvantaged and/or have many children who attend public schools.

Although the state would save the cost of purchasing the textbooks for its students, it would have to provide a technical support infrastructure for the laptops. This would

include providing staff and faculty with computer training sessions and the resources and time for reorganizing the educational curriculum. Another hidden cost involved in the plan is a rapid increase in school electricity bills. As the essence of owning a laptop is its portability, it also has a limited batter supply and would require that students plug-in their laptops for the majority of the school day. Money will also be needed to replace damaged or lost units. The most critical cost, however, would be from having to hire technical support personnel to maintain and upgrade over the over four million laptop computers in Texas.

When looked at critically, the cost savings that the board promises with Texas laptops are highly improbable, if not impossible. Given that the current industry technical support model states that one systems administrator (who is paid typically $50,000/year) is needed for every 100 computers, the monthly cost of providing a technical infrastructure in Texas would be $42/month. Added to the $10 monthly payment that parents would be required to pay for each of their child's laptop lease, it is unimaginable that parents would be able to incur such costs. If the state agreed to pay the fee, there would be an increase of $54 per student. These figures certainly not equal cost savings for the Texas State Board of Education.

It has also been argued that an additional cost of Texas laptops is that the educational content of material will be abandoned for "edu-tainment." Professionals have commented that, although computers in the classroom provide a useful adjunct to teaching, they should in no way become a school's predominate resource. It is these professionals' opinion that access to information is not the reason why K-12 have been having problems. They argue that the causal agents to problems in public schools have less to do with access to information and more with student apathy, student home lives, and students' pre-occupation with popular culture and consumerism.

Distribution

The final step in the process of replacing printed textbooks with electronic textbooks is distributing the laptops to each student. The execution of issuing laptops to millions of students will be a gradual process. Estimates range from the fall of 2001 to at least 2004. Nonetheless, it is important to ask how the order in which schools receive their laptops would be determined. Although Section 3135 of the federal Elementary and Secondary Acts states that special considerations are to be given to districts who have demonstrated a need for technology and with a percentage of its students identified as economically disadvantaged, will school districts who have not shown extreme interest in technology or who have students that will have a more difficult time in paying their lease payment be given their laptops later than other school districts?

This point is made in lieu of the $33 million in federal funds that the Texas Education Agency (TEA) awarded to 25 school districts in June, 2000. The grants, ranging from $92, 000 to $2.9 million were given to school districts who had developed projects that will actively promote online curriculum delivery, distance learning, technology professional development, enhanced administrative operations and other activities whose

main goal is to improve the quality of education students receive and increase student performance. Although special concern was to be given to schools with little or no technology or economically disadvantaged students, there is no way of telling the extent to which the TEA followed those rules. Hypothetical scenarios range from schools being given grants because they had formed associations with certain TEA members to school not receiving funding to improve the quality of education to students simply because they are located in a region where there was little publicity about the grants and thus was unaware of the grants. Although both of these scenarios are fictitious, it still shows the lack of specificity with which allocation of funding and resources may be distributed.

Ethical issues

- Safety Hazards. These include the possibility of electrical shock and individuals attempting to rob them of their computers. Another hazard results from the toxic chemicals used in laptop batteries as well as other laptop components such as the monitors.
- Environmental Hazards. Increased manufacture of computer components magnifies existing environmental hazards in computer manufacture. (Z-corp type issues) Moreover, four million laptops would create serious disposal problems when the computers become obsolete. Who would be responsible for disposal? What possibilities could be designed into the computers for recycling? How would costs for recycling be equitably distributed among the state, vendors, manufacturers and consumers?
- Other environmental hazards would arise in the manufacture, use and disposal of peripheries such as printers, printer cartridges, and papers.
- Intellectual Property Issues. These surround the copyrights of printed texts and extending and preserving these rights as printed material is converted into electronic media. This becomes difficult given the different character of electronic textbooks. They present advantages (more readily copiable, flexible, capable of being extended through hyperlinks) and disadvantages (copiability makes protecting author rights more difficult, tendency toward infotainment, and their dependency on computer mediation). Updates are easier but they also blur distinction between current and new editions undermining publisher control and profit. Finally, ip issues arise concerning who owns the material that students and teacher store in their laptop computers. The schools or state since they own the computer? Or those who entered the data?
- Privacy issues also arise as we discuss who has access to the material stored in laptop computers. This would also include authorized and unauthorized access to computers that connect to the internet. For example, wireless internet connection make users especially vulnerable to unauthorized access.
- Equity and Access. Providing all students with access to computing technology, especially students with special needs and challenges (blind, deaf, impaired), students from poor families, and students from families who may not have infrastructure and peripherals that are needed by laptop users. For example, should students be able to take there laptops home to study and do homework? If so, then this raises a series of problems including safety problems mentioned above. If not, then students economically challenged are put at a disadvantage in relation to those better off. (Who have computers at home, etc.) Another equity and access issue would include

the vendors chosen. Would these be local vendors or would local vendors be passed over in favor of national and international providers?