

Conditional Support of
One to One Technology Immersion
from a Critical Educational Theorist's Perspective

Wesley A. Fryer

Texas Tech University

December 6, 2004



This article is awaiting print publication in December 2004, but is available online at www.wesfryer.com/onetoone. It is available for your use under the Creative Commons Attribution-NonCommercial-ShareAlike 2.0 license. More information about this license is available on <http://creativecommons.org/licenses/by-nc-sa/2.0/>.

Commitment to and participation in the educational process for the young as well as the old remains a noble yet underappreciated, under compensated, and poorly understood profession in the early twenty-first century United States of America. Broad consensus exists that education is important and educational processes as well as outcomes should always be improving, but sharp disagreements persist about the ways “high quality education” can be promoted and measured. Policymakers currently exercise an unprecedented level of centralized control and curricular management at state and federal levels, predominantly through the prolific creation of mandated standards and assessments. In this environment of high-stakes testing amidst a dizzying array of officially outlined educational expectations, general consensus also exists that:

- 1- Like businesses, schools should be more efficient so their educational “outcomes” or “products” are improved.
- 2- Technology can and should play a fundamental role in the transformation of the educational environment and the improvement of educational ends.

For almost two decades since computers were introduced into classrooms in the early 1980s, a vocal and proactive constituency composed of business leaders, parents, politicians, academics, and technology company representatives have heralded the personal computer as a device with unprecedented potential to bring about a positive transformation in education. This transformation is viewed as analogous to the changes wrought in the business community by the efficiency-encouraging influence of technology. These advocates have focused on reducing local, state, and national “student to computer ratios,” pushing local school boards as well as state and federal education agencies to allocate increased funding for the purchase and installation of computer hardware, software, and network infrastructure. This effort to bring a ubiquitous presence for technology and connectivity to the “information superhighway” in US

classrooms has been measurably successful. Although the “digital divide” separating households with computer technology from those without continues to narrow, the vast majority of K-12 classrooms in the United States today have at least one computer connected to the Internet available for teacher and/or student use (Kerr, 10). Despite the phenomenal expenses required to bring technology to the vast majority of US classrooms, however, “dominating teaching practices [have] remained largely constant in the years of greatest penetration of new technologies” (Cuban, 129).

Given this widespread faith in the potential for technology to positively impact the educational environment and its eventual outcomes, alongside the failure of expenditures and educational technology training programs to bring about these expected results, the present emphasis in educational policy circles to promote “one-to-one” technology immersion programs in schools should not come as a surprise. According to some estimates, by the year 2000 over one thousand US schools were already implementing programs to provide each student at school with a laptop computing device (Milloy.) The state of Maine’s initiative to provide every sixth, seventh and eighth grade student with an iBook laptop computer was largely due to the vision of its former governor, Angus King. King was strongly influenced by educational technology proponents like Seymour Papert, who vigorously championed the necessity of making the student to computer ratio one to one, rather than one to even a few, to realize the goal of positively transforming teaching and learning environments throughout the state (Snow).

Indeed, one-to-one technology immersion projects have become the educational “reform de-jure” in the early twenty-first century, enthusiastically promoted by a diverse group of advocates with utopian promises for positive educational change. Although scientifically designed studies are lacking, schools and school districts implementing one-to-one immersion

projects are anecdotally championed as having higher rates of student attendance, lower dropout rates, higher levels of student engagement in the educational process, better writing skills, and improved computer literacy skills essential for success in the twenty-first century economy.

Where other reforms have failed to change general instructional practices, one-to-one technology immersion is evangelized as the panacea for education's many ills: improving levels of parent involvement in children's education, increasing levels of communication between teachers and parents, and tangibly bridging the digital divide which threatens to withhold the promises of better educational and vocational opportunities for a large segment of society within our information driven, service-based, post-industrial third wave economy.

In the fall of 2003, the Texas Education Agency applied for \$12 million of Federal Title II, Subchapter D, No Child Left Behind (NCLB) funds with the express purpose of conducting a large scale, scientifically designed study of one-to-one technology immersion. The Technology Immersion Pilot (TIP) project began in fall 2004, with 22 junior high campuses across Texas designated as "experimental" or immersion campuses, and 22 other campuses designated as "control" campuses. This quasi-experimental research design matches campuses based on several factors, including student demographics, geography, and campus size. For the first time in US history, the prospect of generalizable research conclusions concerning the impact of one-to-one technology immersion appears to be realistic and imminent (Shapley).

Amidst the fervor of support and millions of tax dollars spent by state and local education agencies for one-to-one technology immersion projects, it is vital for educational stakeholders to critically analyze the key assumptions and beliefs on which these programs are based, as well as the outcomes they profess to advance. Through this critical analysis, concerned stakeholders may develop a conditional framework for supporting one-to-one technology immersion programs that

serve not only the narrow interests of improving individual student learning and achievement, but also the broader interests of preparing a literate citizenry for vocational success and effective participation in our democratic culture.

In the genre of critical educational philosophy and pedagogy, Brazilian educator Paulo Freire stands out as an internationally recognized and widely acclaimed expert. While Freire never would, in life, have promoted his ideas as a universal recipe for educational reform in every context, his educational ideals and approach can serve as a helpful measuring stick and lens of analysis. To apply Freire's pedagogic principles in an analysis of past, current, and proposed one-to-one technology immersion programs, several things must be clarified and examined. First, the four-fold chain of assumptions which serves as an anchor of faith among the educational technology evangelist constituency must be identified and explained. Second, the viability of a technology program implemented within the existing educational culture to serve as a positive agent of change for the underprivileged and oppressed within our society should be challenged. Third, a paradigm for desired educational reform and transformation should be outlined. Consensus exists that improved educational outcomes are desired, but how can those outcomes be efficiently and cost-effectively encouraged, and how can they operationalized? Fourth, contrary visions of pedagogical transformation should be identified and explained. The constituency supporting one-to-one technology immersion is broad, but certainly not unified in its values or ideals about the instructional environment or educational outcomes. Fifth, the proposition that one-to-one technology immersion environments can promote student critical thinking and authentic twenty-first century literacy skills must be carefully examined. What are the authentic skills needed in our twenty-first century workforce, and can the mere presence of technology (even when its ratio is one-to-one) necessarily bring about the realization of those

skills for every graduate of immersed schools? Sixth, past results of intensive educational technology integration efforts as well as one-to-one technology immersion projects should be carefully examined. Finally, the conditions under which a “dialogical” one-to-one technology immersion program can promote the development of a culture of authentic critical consciousness, as defined by Freire, should be considered. Through this analysis, it will be demonstrated that pedagogy, far more than technology, will be the most important factor shaping the quantitative and qualitative nature of instructional change and outcomes resulting from one-to-one technology immersion.

1. The Four Fold Faith of Educational Technology Evangelists

Attending an educational technology conference, like the Texas Computer Education Association’s annual February gathering in Austin, Texas, in many ways represents a pilgrimage of the faithful. Just as religious zealots trekking to a holy shrine share basic values and beliefs about the world and their place in it, so too do many teachers, administrators, students, parents, policymakers and technology vendors share an abiding faith in the power of technology to positively transform teaching and learning at all levels. In his thorough and meticulous analysis of educational technology uses in different K-16 contexts in Silicon Valley, California, Dr. Larry Cuban documents in Oversold & Underused: Computers in the Classroom the general failure of educational technology to bring about fundamental changes in instructional practice. Teachers at all levels tend to continue teaching in the traditional ways they were taught, despite the availability of computers in their classrooms and school computer labs.

In addition to documenting this generalized failure of educational technology to bring about prophesied reforms, Cuban also thoughtfully outlines the four fold faith of educational

technology evangelists. This faith involves the following “interlocking chain of reformers’ assumptions:”

- 1- Students should be provided with increased access to computer technology at school.
- 2- Increased access to technology will lead to increased student and teacher use of technology.
- 3- Increased use of technology in the classroom will lead to a transformation of instructional practice (teaching and learning)
- 4- As instructional practice is transformed, student achievement improves (Cuban, 34).

These assumptions form the foundation for the educational evangelists’ claim that one-to-one technology immersion is a panacea for many problems facing K-16 education. To Cuban’s research conclusions concerning educational technology’s failure to bring about transformed instructional practices and improved levels of student achievement across the board, technology immersion evangelists would likely reply that studied populations were not immersed: student to computer ratios were 1:5, 1:3, or another ratio, but not at the magical 1:1 level.

This assumption and faith in the power of educational technology to bring about positive educational change is held not only by the one-to-one immersion constituency, but also by a large percentage of the voting population. The transformative impact of technology upon business practices is widely acknowledged and well-known. Policymakers discussing educational issues have adopted a framework for analysis and point of view which assumes, simply put, that education is a business. Instead of producing a profit measurable in dollars, however, schools are engaged in a defined, scientifically explainable process of producing an

educational product: the literate high school or college graduate: knowledgeable, skilled and ready for vocational success in the twenty-first century economy.

In addition to assuming that education is like a business and technology can have a similarly transformative effect in improving “efficiencies” in the classroom, policymakers have established a framework for educational analysis almost wholly focused on measurable and quantifiable outcomes. As Neil Postman noted in Technopoly: The Surrender of Culture to Technology, our society is enamored and awed by the allure of scientific, measurable studies and surveys. The tables of comparative student performance between school districts and among individual schools, published annually in newspapers across the state of Texas, resonate at a very basic level with the average taxpayer. Laid out in black and white, in a table of statistical numbers comparing student test scores in math, reading and writing, educational quality appears to be a defined and measurable outcome like corporate profits or stock prices on the world’s exchanges.

In analyzing the potential value of one-to-one technology immersion programs from a critical educational theorist’s point of view, therefore, it is vital to understand the professed (if not formally recorded) articles of faith accepted by many in early twenty-first century US culture. Faith in the four fold assumption of educational technology’s promise to transform and improve teaching and learning, the unyielding faith of the electorate in quantitative, statistical comparisons of measured student achievement, and apparently limitless faith in the potential for curriculum standards and mandated student assessments to improve educational practice and outcomes largely define our present political and educational landscape.

2. Viability of Technology Reform to Champion the Needs of the Oppressed

Critical educational theorists, including Paulo Freire and others, would be and are quick to question the potential for technology to serve as a positive, liberating influence for the poor and oppressed within our society. Typically in critical educational literature, technology is portrayed as an enemy to a humanistic approach to education. Rather than an ally, technology is viewed as an instrument of the oppressive, authoritarian governmental and societal elites who largely determine politics, including educational policy. In his best known book, Pedagogy of the Oppressed, Freire wrote:

More and more, the oppressors are using science and technology as unquestionably powerful instruments for their purpose: the maintenance of the oppressive order through manipulation and repression. The oppressed, as objects, as “things,” have no purposes except those their oppressors prescribe for them (60).

Although Freire was writing about the environment of the oppressed in a specific context: Brazil in the 1960s, Freire’s natural suspicion of and aversion to technology as a source of oppression rather than a liberating instrument from oppression is also embraced by other critical educational theorists. Antonia Darder, in Reinventing Paulo Freire: A Pedagogy of Love, moves beyond Freire’s theses concerning the ontological roots of oppression. She identifies the capitalistic economic system as the “root of domination” and “driven by the profit motives of capitalists” (39.) She argues further that traditional educational practices serve an inherently oppressive role in reinforcing the injustices and inequalities present in the status quo.

Traditional practices of public schooling perpetuate a functional and instrumental view of knowledge that is primarily concerned with whether the student can perform the basic skills and do well on official standardized tests. As such, traditional teaching practices reinforce the superiority of the dominant cultural belief systems and language, at the expense of the cultural values and language of subordinate populations. It is significant to note that this includes the privileging of an imaginary “middle-class” norm that is linked to the perpetuation of a capitalistic political economy, while subordinating the cultural sensibilities, aesthetics, and linguistic patterns of working class populations, irrespective of their ethnicity (Darder, 134.)

These critical perspectives imply that any use of technology to support traditional educational practice is oppressive on a prima facie basis, and therefore not in the interest of poor / oppressed student or adult populations under any circumstance. Critical educational theorists have a generally dim view (to put it lightly) of globalism and capitalistic economic systems, and call for their revolutionary replacement with a more humane alternative. Yet authors like Freire and Darder fall short of proposing specifics for an alternate economic system, and instead content themselves by leveling criticisms at a status quo in need of undefined reforms.

This line of thought among critical theorists is cogent to the present analysis of one-to-one technology immersion projects, since it questions at a very basic level the potential for educational reforms involving technology within our existing institutions to advance the interests of the oppressed. Contrary to the assertions of Darder and other critical theorists adamantly opposed to globalism and our capitalistic, market economy, real wages have increased in both poor and wealthy nations engaged in multilateral trade since the 1980s recession (Baghwati, 3-4). The import of this contrary opinion is significant. If real wages have and can continue to rise for all segments of society in a globalistic economy, the critical theorists' contention that all educational practices which support the economic status quo are contrary to the needs of the oppressed cannot be accepted.

Freire as well as other critical educational theorists seem to reject the notion that our world and socio-economic culture has been fundamentally transformed by technology. Rather, they contend that globalism merely portends continued oppression of the poor / working class in more industrialized nations who lose jobs to the poorer, less industrialized nations. These less industrialized countries are perceived to gain employment at the human cost of workers employed at marginal wages in deplorable and unregulated conditions. These perceived

relationships make this situation (and globalism in general) unacceptable from a critical theorist's perspective.

Freire's contention that traditional educational practices tend to promote conformity rather than critical thinking and the process of conscientização (critical consciousness) should be kept in mind, despite his failure (and that of other critical theorists) to acknowledge the potential for incremental economic improvement, even for the poor and oppressed, in a capitalistic economy (Freire 1970, 19). Of course critical educational theorists are not interested in incremental change, but generally favor revolutionary transformative change. None the less, the bottom line in this area of analysis is that the use of technology to provide job skills for the poor and oppressed in society is not necessarily against the interests of the oppressed on a prima facie basis. If the use of technology tools (including student laptops) in classrooms can lead to the acquisition of vocational job skills that provide employment, including comparatively higher paying employment in service oriented rather than labor-intensive jobs, then technology should not be regarded as definitionally "evil" from a critical perspective. In fact, to the extent that the use of technology in a one-to-one immersed environment may help teachers more effectively promote critical thinking and real world problem solving among students, technology may potentially serve as a dynamic agent of change promoting the very process of conscientização that Freire consistently championed. This conditional support of one-to-one technology immersion projects from the lens of Freire's pedagogical approach will be further explicated in section five, below. It is important to draw attention to this theme of critical theorists at the onset, however, since a one-to-one laptop initiative which is not instructionally transformative: which serves only to reinforce existing paradigms of content delivery and demonstrated student understanding on standardized assessments, would clearly not succeed in winning the support of

critical theory advocates. Only to the extent one-to-one technology programs promote authentic and broad based instructional change leading to dialogical learning environments and conscientização, along with technology related vocational opportunities for disadvantaged students (tangibly bridging the digital divide) can these programs win their support.

Scientifically designed, longitudinal studies of students from low-income households participating in one-to-one immersion initiatives (like those involved in the TIP project) will be required to adequately test this hypothesis.

3. A Desired Paradigm for Educational Reform

US citizens seem unified in their belief that educational opportunities and outcomes should improve at all levels, but uncertain when it comes to defining what “high educational quality” looks and feels like. Steeped in traditional, didactic, teacher-directed paradigms of instructional interaction, educational stakeholders tend to view content-centric, textbook dominated classrooms measured by the ruler of standardized assessments as the only credible model for educational excellence.

Yet as Neil Postman and Charles Weingartner point out in their book, Teaching As a Subversive Activity, most adults can articulate different, more personal ideas about educational excellence when asked to relate a story about their favorite grade school or secondary level teacher. In many cases, favorite teachers were able to establish meaningful affective connections with their students which helped them serve as life-long influences, or at least created life-long memories. Many adults can understand from personal, past experiences that a teacher’s effective use of technology (perhaps an overhead projector, filmstrip viewer, record player or slide projector) was not the defining characteristic distinguishing him or her as a favorite years after

the classroom experience. The demonstrated willingness to care and to love students, and the predominant pedagogical philosophy with which the teacher structured his/her classroom, are more likely to have been critical factors. The use of standardized tests does not stand out as something which made a teacher “great” or “effective.” A basic fact, often missed in contemporary discussions about educational policy, is that “testing is not teaching” (Graves).

One of Paulo Freire’s best known metaphors for the traditional paradigm of teacher-directed instruction is teaching as “banking education.” Under this dominant worldview, students are viewed as empty containers into which instructors attempt to pour content, making “deposits” for later retrieval upon demand. In Teachers as Cultural Workers: Letters to Those Who Dare to Teach, Freire states:

For this reason also, as I have said so many times, *teaching* cannot be a process of transference of knowledge from the one teaching to the learner. This is the mechanical transference from which results machinelike memorization, which I have already criticized. Critical study correlates with teaching that is equally critical, which necessarily demands a critical way of comprehending and of realizing the reading of the world and that of the world, the reading of text and of content (22).

In Pedagogy of the Oppressed, Freire describes the banking paradigm for education in detail:

In the banking concept of education, knowledge is a gift bestowed by those who consider themselves knowledgeable upon those whom they consider to know nothing. Projecting an absolute ignorance onto others, a characteristic of the ideology of oppression, negates education and knowledge as processes of inquiry. The teacher presents himself to his students as their necessary opposite; by considering their ignorance absolute, he justifies his own existence. The students, alienated like the slave in the Hegelian dialectic, accept their ignorance as justifying the teacher’s existence —but, unlike the slave, they never discover that they educate the teacher (72).

While Freire wrote primarily about the educational context in Brazil, his observations and analysis of traditional educational paradigms remain relevant within our twenty-first century educational environment.

Concerning the need for educational reforms in US classrooms in 2000, Larry Cuban

cites the following statement by former IBM Chief Executive Officer Louis Gestner, Jr.:

Before we can get the education revolution rolling, we need to recognize that our public schools are low-tech institutions in a high-tech society. The same changes that have brought cataclysmic change to every facet of business can improve the way we teach students and teachers. And it can also improve the efficiency and effectiveness of how we run our schools (Uchitelle).

Gestner's declaration reveals his contention, also accepted by many current US policymakers as well as political constituents, that education can and should be treated just like a business where profits (outcomes) are the bottom line. This line of thinking might be valid if the predominant measures of educational excellence were valid and comprehensive, but unfortunately they are not. State level standardized tests in content areas including reading, mathematics, writing, science and social studies, the SAT, ACT, and GRE fail to measure and reflect many of the qualities and characteristics essential for high quality education.

What are these "hallmarks of good education?" I submit the following as a partial list:

- 1- Engaged learners taking part in an active instructional process
- 2- A loving and caring teacher
- 3- Respect for and cultivation of affective as well as cognitive connections between the teacher and students
- 4- Emphasis on activities and study which build upon existing schema in the minds of learners
- 5- Emphasis on activities which lead to long term learning and retention, rather than strictly short-term recall
- 6- Work involving collaboration with peers as well as individual study, reflecting an understanding of learning as an inherently social process
- 7- Classroom interactions which encourage the natural curiosity of students and the development of student creativity and use of imagination
- 8- Emphasis on activities which allow each participant in the learning process to express his/her voice to an authentic audience beyond the traditional "audience of one" (the teacher)
- 9- Instruction which reflects the conceptual synthesis of content areas: the continuum of literacy which transcends discrete content areas like reading, writing, language arts, social studies, science, etc.
- 10- Teaching behaviors and attitudes which belie an attitude of joy and hope in the essential process of learning and discovering together with students.

Each of these suggested hallmarks of quality education deserves in-depth analysis and explication, but in the interest of brevity and maintaining focus on the central topic of considering the potential benefits of one-to-one technology immersion, only a few will be highlighted here.

Learning is an inherently social process. Human beings are by nature social creatures, yet traditional banking education seeks to defy nature and impose a one way, isolated and individualistic approach to learning that is inherently dehumanizing if it is the dominant pedagogical form. John Dewey identified the essentially social nature of learning, writing in 1897:

I believe that much of present education fails because it neglects this fundamental principle of the school as a form of community life. It conceives the school as a place where certain information is to be given, where certain lessons are to be learned, or where certain habits are to be formed. The value of these is conceived as lying largely in the remote future; the child must do these things for the sake of something else he is to do; they are mere preparation. As a result they do not become a part of the life experience of the child and so are not truly educative (EW 5:88.)

As John Naisbitt thoughtfully observed in High Tech, High Touch: Technology and Our Search for Meaning, modern day citizens often seem oblivious to the tendency inherent in some technologies to encourage us to live our lives increasingly distanced and distracted. Modern computer technology, with its attendant capabilities for email communication, dialog via weblogs and even videoconferencing certainly is not, by nature, an exclusively isolating influence. Technology accommodated within an existing educational banking paradigm of instruction, however, can serve to reinforce dominating, isolating methodologies and ignore the essentially social nature of human learning and cognition.

Just as banking education, with or without the use of computer technology, can fail to respect and encourage student social learning, it also often fails to encourage the inherent curiosity of students. Banking education generally fails to value and cultivate the development of student creativity and imagination. As Freire wrote in The Pedagogy of Freedom:

What is essential is that learners, though subjected to the praxis of the “banking system,” maintain alive the flame of resistance that sharpens their curiosity and stimulates their capacity for risk, for adventure, so as to immunize themselves against the banking system. In this sense, the creative force of the learning process, which encompasses comparison, repetition, observation, indomitable doubt, and curiosity not easily satisfied, overcomes the negative effects of false teaching. This capacity to go beyond the factors of conditioning is one of the obvious advantages of the human person. Of course, this capacity does not mean that it is a matter of indifference to us whether we become a “banking system” educator or one whose role is essentially to “problematize,” to use the critical faculty (32-33).

It is essential that teachers seek to cultivate instructional environments where student creativity and imagination are not quashed and silenced. As discussed below in section five, concerning authentic vocational literacy skills in the twenty-first century, the abilities to “think out of the box,” take reasoned risks, and formulate innovative solutions to age-old or recent problems are basic needs within our culture. Traditional banking education, however, does not naturally encourage this praxis.

In Teachers As Cultural Workers, Freire offers a fervent plea to educators to operationalize this need to encourage student curiosity and imagination within instruction.

Teachers must give creative wings to their imaginations, obviously in disciplined fashion. From the very first day of class, they must demonstrate to students the importance of imagination for life. Imagination which we cannot create. I speak here of imagination that is naturally free, flying, walking, or running freely. Such imagination should be present in every movement of our bodies, in dance, in rhythm, in drawing, and in writing, even in the early stages when writing is in fact *prewriting*—scribbling. It should be part of speech, present in the telling and retelling of stories produced within the learners’ culture. The imagination that takes us to possible and impossible dreams is always necessary. It is necessary to stimulate the learners’ imagination, to use it in “blueprinting” the school they

dream of. Why not put into practice right in the classroom the school they dream about? Why not, in discussing imagination projects, point out to students the concrete obstacles to attaining imagination, obstacles that, for the time being, are not easily overcome? Why not emphasize their right to imagine, to dream, and to fight for that dream? (51).

This empowering, liberating paradigm of educational praxis distantly resembles banking education, yet must be embodied in present conceptions of “educational quality” and “educational reform.” While perhaps difficult to quantitatively measure, it none-the-less forms an essential part of this vision for desired educational reform from the perspective of critical theorists.

A last element in this alternative paradigm for quality education in need of examination is the conceptual continuum of literacy skills. In public education, everyone seems to be in a thoughtless race to move students into a secondary model of discrete content area based instruction, where the daily schedule is neatly divided into discrete topic areas of instruction in writing, then mathematics, then reading, etc. Freire commented on this tendency in Teachers as Cultural Workers, writing:

One of the mistakes we often make is to dichotomize reading and writing and, even from children’ earliest steps in the practice of reading and writing, to conceive of these processes as detached from the general process of knowing. This dichotomy between reading and writing follows us forever, as students and as teachers. “I have a tremendously hard time writing my papers. I cannot *write*” is the comment I hear most frequently in the graduate programs I have been involved with. Deep down, this fact reveals the sad fact of how far we are from a critical understanding of what it means to teach and to learn (24).

The home schooling movement is a widespread, current example of educational praxis which has demonstrated potential to transcend this systematic scheduling mistake within traditional public schooling. Teachers and students alike are generally beholden to the tyranny of the bell schedule, which tangibly enforces strict boundaries upon the starting and stopping times for potential learning. Home schoolers, by contrast, have much more autonomy and freedom to determine

their own schedule of study than participants in public schooling. Home schooling is not without its share of drawbacks and limitations, however, and our focus today is not to analyze those characteristics. The salient point relevant to our present analysis of one-to-one technology immersion is that instructional approaches, in an ideal vision, should tend to NOT dichotomize learning into discrete content areas. The reading/writing workshop model of literacy development is a prime example of a pedagogical method that allows teachers and students to operationalize a more holistic view of literacy development.

To summarize, basic assumptions about educational quality and visions for educational outcomes and reform vary widely. From a critical educational theorist's perspective, a banking model for instruction must be rejected and replaced with authentic opportunities for teacher / student interaction, characterized by many of the "hallmarks of good education" mentioned above. Education cannot be properly viewed as a business, with operationalized outcomes analogous to profits and the corporate bottom line. The pedagogical philosophy with which the teacher and students approach the classroom is essential in defining the quality and types of interactions which are encouraged and valued there. Technology may be able to serve a constructive role in this pedagogical approach, but it is not a necessary requirement or a deterministic factor in the shaping of that environment. Technology is merely a tool, which can potentially be used for good or for ill depending on the attitudes and intents of the user.

4. Contrary Visions of Pedagogical Transformation

As previously mentioned, consensus is absent in academic and educational policy circles concerning the pedagogical transformation desired as the outcome of school reform efforts, including those encouraged by one-to-one technology immersion projects. Since the launch of

Sputnik in 1957 and the emergence of national science curriculum standards, US teachers have generally experienced a progressive loss of curricular freedom and autonomy in the classroom. This tendency is generalized and has several positive aspects, but the cumulative effect of this trend on instruction in the early twenty-first century is pronounced. Darder wrote in 2002:

In many ways, teachers replicate the same fears, frustrations, and insecurities as their students when they hit unfamiliar territory and receive no substantive support in developing their teaching abilities within the context of their everyday practice. Moreover, teachers experience enormous constraints as a result of the politics of the punishment and reward system used by administrators to control teacher behavior. This is reflected in the authoritarian manner in which many school administrators seek to limit the decision-making role of teachers through prescribing rules for dress, conduct, curricula, textbooks, lesson plans, classroom activities, student assessment, and the nature of parent participation (59-60).

These behaviors may not originate with the administrator, however, although most school administrators have been conditioned and steeped in this authoritarian, autonomy-limiting educational paradigm for their entire career. These behaviors today also have an external stimulus found in the imposition of extensive curriculum standards and regular student assessments required by the local district, state education agency, and now federal government.

The net result of these influences upon general classroom instructional practice is significant. Many experienced teachers perceive themselves to have little autonomy and freedom within their classroom relative to previous years before the onset of high stakes testing. Classroom activities are often dominated with explicit test preparation activities, where students read problems and passages and answer sample multiple choice questions. Benchmark testing in advance of the “real” statewide assessment is increasingly common. In some school districts, students are reportedly being formally assessed more than seventy times per year, begging the question whether or not teachers and students are actually doing more testing than teaching and learning in the classroom (Valenzuela).

While Donald Graves is accurate in his claim that testing is not teaching, testing is not an activity devoid of student learning. Students do learn many things from our current environment of high stakes testing, including (for many) a fear of school and high stakes tests and the idea that the world is supposed to be black and white with only one correct answer choice (along with three clearly identified and limited alternatives.) Students learn that writing must be done according to a sharply defined rubric and model, with little room for creativity or original approaches. Canned, scripted instruction is equated with public school learning, creating a distaste for the educational process and classroom experiences in general. In short, our current climate is burning out teachers, denying for them the essentially artistic rather than scientific nature of the teaching process, and causing our children to loathe and fear school because of the absence of authentically engaging, joy and creativity-inspiring activities which generally characterize it.

Some members of the constituency supporting one-to-one technology immersion regard computerized assessment as an ideal, future outcome of these programs. The prospect that students will be able to be assessed even more regularly than they are presently through computerized, web-based examinations is seen as a benefit rather than a curse. Utopia for these champions of digitally enhanced banking education is defined by quickly aggregated student test scores for reading, writing, mathematics, and other measured content areas, available at the click of the mouse for any district administrator or education agency employee to see. Use of one-to-one technologies (student and teacher laptops) within this vision is not transformative, it is in fact oppressive, in exactly the same way Freire and Darder (previously cited) view traditional banking instructional practices to oppress. What teachers and students in today's classroom need is less time allocated for testing, and more time allocated for authentic academic engagement and

study. This vision of ubiquitous, computerized testing is anathema to a critical educational theorist's vision of desired educational reform.

This oppressive use of educational technology to further control and micromanage instructional practices of teachers is already alive and well outside of one-to-one technology programs. The "Plato Learning" company describes itself this way:

As the leading provider of Personalized Instruction and Standards-Driven Assessment and Accountability, PLATO Learning helps sustain continuous academic improvement for K-adult learners. Our achievement model integrates research, Professional Services and technology to promote academic and career success. Our commitment: Real Learning. Real Results.

The commitment of this company could be more realistically articulated as: "More control over instruction for administrators. Less freedom and autonomy for teachers. Less authentic learning for students." It is ironic that a company committed to the use of educational technology as an accountability stick to bludgeon teachers and students alike into compliance with official district curriculum standards would take the name of Plato, an idealistic philosopher associated with the much more humanistic pedagogy of the Socratic dialog than the banking paradigm of teacher broadcast and student regurgitation prevalent today in most schools. Perhaps such a name serves to better obfuscate educational critics seeking to understand and improve classroom instruction. In a school district fully utilizing the Plato learning solutions, the company website promises the ability for leaders to "Administer Assessments and Make Data-Driven Decisions, Ensure Teacher Quality, Manage District Curriculum Against Standards" much more efficiently and comprehensively. For a banking educator and policymaker, educational technology solutions like this one are a dream come true. For the classroom teacher, principal, or parent committed to the authentic development of critical consciousness, however, products with a governing philosophy like this one may represent a "big-brother is watching" nightmare-come-true.

5. Can Authentic Promotion of 21st Century Literacy Skills Support Conscientização (Critical Consciousness)?

A great deal of rhetoric abounds in educational policy circles regarding the need for students in schools to acquire computer literacy and various digital literacies needed for vocational success in the network economy of our present information age. The “digital age literacies” identified in the EnGUAGE framework for effective educational technology use, sponsored by the North Central Regional Education Laboratory, include:

- Basic Literacy
 - Scientific Literacy
 - Economic Literacy
 - Technological Literacy
 - Visual Literacy
 - Information Literacy
 - Multicultural Literacy
 - Global Awareness
- Inventive Thinking
 - Adaptability and Managing Complexity
 - Self-Direction
 - Curiosity
 - Creativity
 - Risk Taking
- Higher-Order Thinking and Sound Reasoning
 - Effective Communication
 - Teaming and Collaboration
 - Interpersonal Skills
 - Personal Responsibility
 - Social and Civic Responsibility
 - Interactive Communication
- High Productivity
 - Prioritizing, Planning, and Managing for Results
 - Effective Use of Real-World Tools
 - Ability to Produce Relevant, High-Quality Products (Lemke)

Despite the acknowledged need for students to develop this broad range of literacies far exceeding “the three R’s,” textbook based / banking instruction remains a predominant

instructional model in many US classrooms. Evidence of this can be seen in the assessments championed by policymakers and some educational reformers, which are almost universally standardized, multiple-choice instruments that cannot authentically measure the previously mentioned literacy domains.

In addition to the literacies included in the EnGuage framework, I offer the following as required workforce employee skills for the twenty-first century. Many of these overlap with categories included in EnGuage, but some are different:

- 1- Teamwork / collaboration skills
- 2- Critical thinking skills (ability to formulate a question/hypothesis, gather information, validate and distill information, synthesize information, formulate solutions or observations based on that synthesis, and critically evaluate one's own process of critical analysis)
- 3- Navigational technology skills (as distinct from procedural technology skills, which are simply the ability to follow directions carefully outlined by another)
- 4- Ability to be a lifetime learner
- 5- Ability to learn and work independent of a another's direction
- 6- Ability to organize resources to accomplish a task, stay organized, and be accountable for the results of the task
- 7- Ability to take reasoned risks

We need to graduate literate netizens from our schools, who are aware, caring, and engaged individuals. While some educational observers may lament our present age of overwhelming amounts of Internet information and misinformation, the era of the textbook and the encyclopedia as the primary sources of information for student study and research is clearly over (Fryer).

The historical banking model of classroom instruction, previously described, is inadequate to prepare students to be authentically, digitally literate. Digital literacy is in some ways analogous to Freire's conception of "conscientização," or critical consciousness. In Education for Critical Consciousness, Freire encourages educators through their classroom praxis to help students grow in their self-perception, from mere objects of history to subjects of

history. People who perceive themselves as historical subjects understand, recognize, and act upon their unique human capability to perceive and change the objective facts of reality. Put another way, students immersed in a culture of conscientização are not mere recipients and parrots on demand within an educational banking system, but rather are active agents engaged in an ongoing process of study, discovery, and action about the circumstances of their present environment.

To the extent one-to-one technology immersion projects promote an authentic environment of conscientização in the classroom, digital literacy skills may be supported. In this context, one-to-one technology immersion could win the support of critical educational theorists as well as those already self-identified as part of the constituency supporting educational technology reform.

6. Past Results of One-to-One Technology Immersion Programs on Student Achievement

As already discussed, predicted positive effects for any type of educational technology solution placed into a classroom is generally an article of faith among the strident advocates of technology in schools. The conclusions of John Schacter, in his 1999 analysis of the “5 largest scale studies of educational technology to date,” is representative. He concludes that generally, in hundreds of “empirical research studies,” “positive gains in achievement on researcher constructed tests, standardized tests, and national tests” were observed (3, 9). This conclusion might be taken as a carte-blanche endorsement for educational technology use of any type, as a likely instrument for improving student achievement.

While this conclusion surely makes educational technology vendors salivate, it is misleading and not rigorous from the perspective of scientifically designed research

methodology. Schacter concludes that “There is, however, evidence in some of these studies that learning technology is less effective or ineffective when the learning objectives are unclear and the focus of the technology use is diffuse” (10). In other words, mileage varies greatly. It is disingenuous to assert, much less claim as the conclusion for “most of the current research” about educational technology, that regardless of type or the way in which it is used in the classroom, educational technology does and will produce higher levels of student achievement. This caveat at the end of Schacter’s research summary is pivotal. Put in other words, it means that the ways technology tools are used or not used in the classroom has everything to do with whether or not student achievement is positively or negatively impacted. It is pedagogy, not technology, which is the most critical factor in this analysis.

In their study on behalf of Rand Education in December 2003 of the Quaker Valley (Pennsylvania) school district’s one-to-one laptop program, researchers observed this same phenomenon: stakeholders have broad faith in the positive potential for educational technology to impact student achievement, but must pay careful attention to the ways it is used and the ways outcomes are measured.

First, many educators and policymakers believe that educational technology will help to increase students’ learning and academic achievement. A direct relationship between computer use and student achievement is challenging to identify and quantify since the link may depend on how the technology is used as well as on how achievement is defined and measured (Kerr, 11).

In his 2004 analysis of research conducted and needed regarding the impact of one-to-one technology initiatives, Andrew Zucker observed:

Research has not yet provided policymakers with enough hard evidence of the benefits and costs of 1:1 computing to help them determine if the initiatives are worth what they cost, nor has research established the mix of factors that make 1:1 computing more or less effective (371).

Stated in other words, we (the educational community) cannot say with confidence that one-to-one technology immersion programs will necessarily lead to improvements in student achievement. Our policymakers and educational decision makers continue to operate on articles of faith regarding the positive role of technology to encourage desired academic reforms, but these benefits have yet to be demonstrated broadly in a scientifically designed, generalizable study.

The same RAND Education study for the Quaker Valley School district concluded that in this limited context,

Students had increased confidence, more willingness to work with and teach other students, and improved communication skills. Some students were reported to take more responsibility for their own learning.... Positive impacts for teachers included the availability of new materials and activities for lessons, and increased capacity for communication with students, parents, peers, and principals (Kerr, xii).

Negative findings were also reported, however, including:

Inappropriate [computer] use, and for some students, social difficulties due to excessive use of the computers.... teachers also reported an increase in workload related to using the technology for both administrative and instructional purposes (Kerr, xii).

In a series of quantitative and qualitative studies conducted over several years evaluating the impact of a one-to-one technology immersion (laptop) project in Walled Lake Consolidated Schools, Michigan, researchers observed improved writing skills and improved levels of measured student critical thinking skills, for students in classrooms with laptops relative to those without one-to-one technologies. Representative of studies of this type, however, researchers concluded that “Given the ex post facto design employed in this study, the present results can be considered only suggestive rather than conclusive about the benefits of the laptop program” (Lowther, 43).

Research results emerging from the highly touted Maine Learning Technology Initiative (<http://mainelearns.org>) are similarly limited in the generalizability of their conclusions. The April 2004 report, “Finding Proof of Learning in a One-to-One Computing Classroom,” includes the following “bottom line” conclusions:

Being a student in a one-to-one, high-speed, wireless computing classroom makes a difference for learning. The changes involve:

- the way students learn
- what is learned
- the people with whom students learn
- students’ personal context for learning
- the way students think about their learning
- who students interact with about their learning as they are learning
- the context for teaching
- students’ ideas about what matters in their work
- on the kind, quantity, and quality of the evidence of student learning
- the role students and teachers have in showing proof of their learning
- accounting for individual student learning using report cards with letter grades, District Writing Prompt Scores, Local Assessment System, or Maine Educational Assessment (Davies, 1)

The implicit assumption is that the introduction of wireless computing devices (iBook laptops) into the instructional environment has produced these classroom level changes in teaching and learning. The key and perhaps more foundational pedagogic changes which were incidental or intentional to the introduction and use of one-to-one laptops in this classroom should be differentiated and studied, however, for observed changes in the classroom to be holistically and accurately understood. This understanding is critical not only from an academic standpoint, but also from a policymaking perspective. Policymakers want to know if one-to-one technology immersion will necessarily result in improved student achievement, or if that result is conditional, what “mix of factors” is most likely to contribute to that outcome (Zucker, 371).

7. Conditions For One-to-One Dialogical Conscientização

Despite the fervent wishes of many policymakers, educational agents (including teachers and administrators) seem to defy well-intentioned efforts aimed at encouraging classroom reforms, analogous to the attempts by a novice puppet master to control a complex marionette. Variables abound, and the simple correlational study which educational policymakers seem to want (computers in the hands of every student necessarily produce improved levels of measured student achievement) may remain a pipe dream.

As discussed previously, an analysis of the predicted impacts of one-to-one technology immersion must begin with a basic examination of the assumptions, values, and visions of educational reformers. Adopting the vision of critical educational theorists like Paulo Freire, it does appear possible and realistic that one-to-one technology immersion programs could serve as a positive agent of change for ushering in needed educational reforms: a rejection of the predominant banking paradigm of education as knowledge transference, the use of a problem-based and context rich curriculum building on the existing knowledge and curiosity of the students, and the development of authentic critical consciousness as students and teachers together analyze, interpret, and better understand the world in which we live. For this vision to be realized, several conditions should be met.

First, educational stakeholders must grapple with and resolve the fundamental tension that exists in the modern classroom involving TIME. Time is zero sum: we have twenty-four hours in each day, no more and no less. We allocate our attention and activities during each day in different ways, and the seven-hour school day has been a given for pre-college students for many decades. Teachers and students, as well as everyone else in modern US society, seem awash in information. Curriculum standards issued by various entities continue to “load the

plate” of the classroom teacher, who is expected to teach more content with less time, often to more students. This recipe is ridiculous and is producing measurable negative effects, not only on student learning and motivation to attend school, but also on teacher retention and self-assessed enjoyment of their profession. We simply must get over our fantasy that educational quality is equated with a curriculum that is a mile wide, and an inch deep (Jukes.) Teachers need encouragement from stakeholders at all levels to teach students less content, but with greater depth. We must reject the governing mentality that teachers must “teach it all,” because the result of that mentality is a poor educational experience that cannot possibly hope to advance the cause of critical consciousness. It produces countless hours of meaningless activity for students and teachers which is quickly forgotten, and represents an enormous waste of time, resources, and human potential.

The destructive impact of our governing pedagogy was summarized well by John Holt in 1964, in his book How Children Fail. Holt observed:

Nobody starts off stupid. You only have to watch babies and infants, and think seriously about what all of them learn and do, to see that, except for the most grossly retarded, they show a style of life, and a desire and ability to learn, that in an older person we might well call genius. Hardly an adult in a thousand, or ten thousand, could in any three years of his life learn as much, grow as much in his understanding of the world around him, as every infant learns and grows in his first three years. But what happens, as we get older, to this extraordinary capacity for learning and intellectual growth?

What happens is that it is destroyed, and more than by any other one thing, by the process that we misname education—a process that goes on in most homes and schools. We adults destroy most of the intellectual and creative capacity of children by the things we do to them or make them do. We destroy this capacity above all by making them afraid, afraid of not doing what other people want, of not pleasing, of making mistakes, of failing, of being *wrong*. Thus we make them afraid to gamble, afraid to experiment, afraid to try the difficult and the unknown. Even when we do not create children’s fears, when they come to us with fears ready-made and built-in, we use these fears as handles to manipulate them and get them to do what we want. Instead of trying to whittle down their fears, we build them up, often to monstrous size. For we like children who are afraid of us,

docile, deferential children, though not, of course, if they are so obviously afraid that they threaten our image of ourselves as kind, lovable people whom there is no reason to fear. We find ideal the kind of “good” children who are just enough afraid of us to do everything we want, without making us feel that fear of us is what is making them do it.

We destroy the disinterested (I do *not* mean *uninterested*) love of learning in children, which is so strong when they are small, by encouraging and compelling them to work for petty and contemptible rewards—gold stars, or papers marked 100 and tacked to the wall, or A’s on report cards, or honor rolls, or dean’s lists, or Phi Beta Kappa keys—in short, for the ignoble satisfaction of feeling that they are better than someone else. We encourage them to feel that the end and aim of all they do in school is nothing more than to get a good mark on a test, or to impress someone with what they seem to know. We kill, not only their curiosity, but their feeling that it is a good and admirable thing to be curious, so that by the age of ten most of them will not ask questions, and will show a good deal of scorn for the few who do (Holt, 273-275).

To this damning assessment of public education’s broad effects, we can add today the fears wrought and useless worksheet activities proliferated as a result of our high stakes testing environment. As if banking education could get any worse, our society has further exacerbated many of its problems by immersing members in a deluge of information and insisting that at an extremely young age, students must learn to fear and abhor the educational process. Until we successfully grapple with and resolve this tension involving TIME, no educational reform effort, whether it involves technology or not, can be successful in promoting authentic dialogical education and conscientização.

In addition to time, we must recognize the primacy of relationships in educational contexts. It is not computers which can and will improve the achievement of students, it is a loving and caring teacher. Can money spent by state and local governments encourage teachers to love and care for their students more? It certainly could encourage them to stay in the profession longer, rather than seeking alternative means of employment that provide more adequate levels of compensation to support a household. A study in fall 2004 of projected

educational technology spending in the United States concluded that “Overall, K-12 schools will spend more than \$7 billion on new technologies over the next 12 months” (eSchoolNews). If we add to that projected amount the millions of dollars school districts and states will spend in 2005 to comply with NCLB accountability provisions, every teacher and administrator the United States could be given a hefty raise.

Time and compensation are important issues to address, but the curriculum is equally important. Educational reformers, including many in the ranks of educational technology evangelists, have called for a turn toward “problem based learning” for many years. These approaches are closely in line with Freire’s view of authentic educational practice, which he articulated in Pedagogy of the Oppressed:

At all stages of their liberation, the oppressed must see themselves as women and men engaged in the ontological and historical vocation of becoming more fully human. Reflection and action become imperative when one does not erroneously attempt to dichotomize the content of humanity from its historical forms. The insistence that the oppressed engage in reflection on their concrete situation is not a call to armchair revolution. On the contrary, reflection—true reflection—leads to action. On the other hand, when the situation calls for action, that action will constitute an authentic praxis only if its consequences become the object of critical reflection (65-66).

Valid educational activities must take into consideration the environment and realities of the students’ life, and engage students and teachers alike in a critical process of analysis and eventual action. Schools and educators devoted to a banking paradigm of instruction have mastered the science of presenting information to students in a decontextualized format that is perceived as largely irrelevant to the life and interests of the learner. School curriculum must be retooled to cover less content, but with greater depth, and include content relevant to the learner. As human beings we are not only social creatures, but as previously mentioned, creatures with

innate senses of curiosity that must be tapped and encouraged by formal educative experiences, rather than stifled.

Conclusions

Throughout his lifetime, Paulo Freire encouraged those around him to not just talk the talk, but to walk the walk. In his words:

What is expected of those who write with responsibility is a permanent and continuing search for truth that rejects puritanical hypocrisy or veiled shamelessness. In the final analysis, what is expected of those who teach by speaking or writing, by being a testimony, is that they be rigorously coherent so as not to lose themselves in the enormous distance between what they do and say (Letters to Christina, 3).

If we say we aspire to improve education, let us carefully and deliberately define the better world which we seek to bring about for our children and grandchildren. Let us cogently define the assumptions on which we make our predications, and cite the research studies (or lack of studies) which support our proposals. Let us shorten the distance between what we say and what we do, in the hope that our heightened credibility will strengthen the regard which others have for our analytic studies and carefully considered conclusions.

It is possible that one-to-one technology immersion programs may help bring about positive reforms in the classrooms of our nation. It is possible as well, however, that these programs could support an agenda in sharp opposition to the authentic view of educational praxis advocated by reformers like Paulo Freire, John Holt, and John Dewey. In the final analysis, it will be the predominant pedagogy, rather than the technology, which will determine the direction and scope of impact of one-to-one technology immersion programs on student achievement.

References

- Baghwati, J (2004). Free Trade and Labour. Presenter at the Myths and Realities of Globalization Conference. 3 November 2004, Dallas, Texas.
http://www.columbia.edu/~jb38/ft_lab.pdf.
- Cuban, L. (2001). *Oversold and Underused: Computers in the Classroom*. Cambridge, Massachusetts: Harvard University Press.
- Darder, A. (2002). *Reinventing Paulo Freire*. Boulder, CO: Westview Press.
- Davies, A. (2004). Report at a Glance: Finding Proof of Learning in a One-to-One Computing Classroom.
www.connect2learning.com/cp/publications/assessment_resources/proofoflearning/.
 Accessed 6 December 2004.
- Dewey, John. Citations refer to Early Works (EW,) Middle Works (MW,) and Late Works (LW,) designated by volume number and page number.
- eSchool News: 7(11). "Study Reveals Trends in Ed-Tech Spending."
 November/December 2004.
- Holt, J. (1964). *How Children Fail*. New York: Perseus Publishing.
- Freire, P. (2003). *Education for Critical Consciousness*. New York: Continuum.
- Freire, P. (1998). *Pedagogy of Freedom: Ethics, Democracy, & Civic Courage*. New York: Rowman & Littlefield Publishers, Inc.
- Freire, P. (1998). *Teachers as Cultural Workers: Letters to Those Who Dare Teach*. Boulder, CO: Westview Press.
- Freire, P. (1996). *Letters to Cristina: Reflections on My Life and Work*. New York: Routledge.
- Freire, P. (1970). *Pedagogy of the Oppressed*. New York: Continuum.
- Fryer, W. (2004). Strategies to Address Digital Plagiarism.
www.wtvi.com/teks/04_05_articles/digital_plagiarism.html. Accessed 6 December

2004.

Graves, D. (2002). *Testing Is Not Teaching : What Should Count in Education*. New York: Heinemann.

Jukes, I. (2001). Presentation at the Texas Computer Education Association's annual conference. <http://homepage.mac.com/iajukes/blogwavestudio/index.html>.

Kerr, K.A., Pane, J.F., & Barney, H (2003). Quaker Valley Digital School District: Early Effects and Plans for Future Evaluation. Rand Education publication TR-107-EDU.

Lemke, C. (2003). "21st Century Skills." Part of the EnGauge Framework. Accessed 6 December 2004. <http://www.ncrel.org/engauge/skills/skills.htm>.

Lowther, D.L., Ross, S.M., & Morrison, G.M. (2003). When Each One Has One: The Influences of Teaching Strategies and Student Achievement of Using Laptops in the Classroom. *Educational Technology Research and Development*, 51(3). p. 23-44

Milloy, F. (2004). "Laptop Literacy." Sydney Morning Herald. 4 December 2004. <http://www.smh.com.au/news/Icon/Laptop-literacy/2004/12/01/1101577541172.html>.

Naisbitt, J., Naisbitt, N., & Philips, D. (1999). *High Tech High Touch: Technology and Our Search for Meaning*. New York: Broadway Books.

Plato Learning. www.plato.com and www.plato.com/solutions.asp?mark=district. Accessed 6 December 2004.

Postman, N. (1993). *Technopoly: The Surrender of Culture to Technology*. New York: Vintage Press.

Postman, N. and Weingartner, C. (1971). *Teaching As a Subversive Activity*. New York: Dell Publishing Company.

Schacter, J (1999). The Impact of Educational Technology on Student Achievement: What the Most Current Research Has to Say. Milken Exchange on Education Technology. www.mff.org/publications/publications.taf?page=161.

Shapley, K. (2004). Evaluation of the Texas Technology Immersion Pilot eTxTIP. Presentation to faculty and staff at the Texas Tech College of Education. 5 November 2004.

Snow, D., Frazier, L., Martin, J., & Quinn, K. (2003). "Give Every Maine Seventh Grader an iBook? Are You Serious?" Presentation at the National Educational Computing Conference, 1 July 2003. Notes taken by Wesley Fryer, posted on http://webpages.acs.ttu.edu/wfryer/necc2003/maine_ibooks.html.

Uchitelle L. (2000). "Productivity Finally shows the Impact of Computers." New York Times, March 12, 2000, p. 4BU. Quoted in *Oversold and Underused: Computers in the Classroom* by Larry Cuban, p. 13.

Valenzuela, A. Email correspondence. 27 November 2004.

Zucker, A. (2004). Developing a Research Agenda for Ubiquitous Computing in Schools. *Journal of Educational Computing Research*. 30(4). p. 371-86