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THE HIGH COST OF INCREMENTALISM IN EDUCATIONAL TECHNOLOGY IMPLEMENTATION

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ABSTRACT

Incremental approaches to classroom computer use have been slow to produce significant educational benefits. Criticism of educational computing is often validated by a lack of compelling models created in the absence of vision or adequate leadership. However, this paper departs from critics who suggest that computers should play little or no role in the intellectual lives of children by arguing that the opposite is true. Computational technology needs to play a much greater role in the learning process and is essential to the sustainability of schools.

To chart a new course for the future of learning, we must investigate and analyze the current trends embraced by the educational technology community. This paper asserts that despite the technological nature of these trends, many of the popular interventions do little to advance the goals of progressive educators. In a number of cases technologies such as: WebQuests, educational portals, personal digital assistants, classroom performance systems and eLearning platforms serve as distractions and costly detours along the road to improving the learning environment.

Despite the enormous societal shifts resulting from widespread access to computers and the Internet, schools and other educational organizations remain committed to outdated notions of computer literacy instruction. Such efforts, along with the allure of online delivery and assessment, serve to centralize curriculum at the very moment the identical technology could be used to revolutionize the learning process. Individuals once at the forefront of the learning revolution promised by the widespread availability of powerful computational and communications technology now preside over the use of that technology to reinforce the least effective educational practices of the past. This leads inevitably to a lowering of educational standards and a diminution in the learning opportunities available to young people around the world.

An over-emphasis on ICT limits the computer's potential as an intellectual laboratory and vehicle for self-expression. Less cautious technology use can help bridge the imagination gap and create productive contexts for learning, while engaging teachers and investing wisely.

1. INTRODUCTION

This paper is not offered as an exhaustive review of the literature regarding the current state of educational technology use in schools around the world. No one paper could possibly do so. It is intended to stimulate discussion among members of the academic and practitioner community regarding current trends and their possible consequences. The author bases his observations on work as a teacher educator, consultant, teacher, researcher and educational journalist in schools across the United States and Australia, in addition to recent efforts in Canada, Brazil and India. The author speaks at more than a dozen educational technology conferences annually, consults with industry and writes a magazine column read by approximately 100,000 educational leaders each month. These various activities afford the author a rare perspective from which to identify patterns of rhetoric, policy-making and practice.

Some of the evidence presented in this paper may strain credulity. However, the practices and products in question all exist. Alfie Kohn said, "In education, satire is obsolete."[i] The confluence of the availability of mysterious new technology, an increasingly high-stakes educational system and the capitalistic desire to profit from this tension results in strange, but true challenges for schools.

This paper attempts to alert educators, members of education-related industries and policy-makers to trends that while at first glance appear to indicate progress, especially since they involve high technology, may actually result in expensive detours, distractions and disasters.

Critics (Alliance for Childhood, Cuban, Oppenheimer) often assert that computers do not belong in school for a variety of ideological, financial or developmental reasons. However, I agree with Seymour Papert that computers are today's

primary instrument for intellectual work, and therefore belong in the educational enterprise. If for no other reason than the fact that computers are already a part of the world of kids, we must respect the role they can play in children's lives and develop ways to maximize the potential of technology. I have spent the past twenty-three years helping students use computers in intellectually rich and creatively expressive ways that defy current notions of curricula or educational standards.

After four decades of advocacy for computers in education, Seymour Papert recently corrected the record by suggesting that, "Computer scientists weren't supposed to bring computers into classrooms. They were supposed to bring computer science to children in classrooms." (Papert 2002) Papert contends that the failure to use computers in new ways as an instrument for educational progress is the result of an imagination gap. (Papert 1997)

I postulate that the educational technology challenges associated with teacher professional development, inadequate funding and the demand for standards are not our primary problems. They are symptoms of an imagination gap and shortage of honest reflective practice that threatens to rob children of the potential afforded by advances in communications and computational technology.

Some may view this paper as a cautionary tale. Others may find that it affirms their tacit concerns while some will violently disagree with my hypotheses. This paper should not however be misconstrued as an argument against the widespread of use of computers and related technologies in appropriate ways across all subjects and grade levels. Many critics of educational computing alert us to the trivial ways in which computers are used. If school computers are used in dubious ways, the solution is not the abolition of computers, but more thoughtful practice.

It is remarkable that there are proponents of a view that computers should play no role in education despite the transformational impact they have had on nearly every other aspect of society. Like many other educational innovations, the use of computers in schools may be dismissed as a failure before it was seriously attempted. It is well-known, but seldom mentioned, that most children touch a computer for minutes per week while in school. It is ridiculous to assign failure to the computer when access is so low and a vision for its use eludes most educators.

The lack of critical dialogue from within the educational technology community regarding the issues raised in this paper, as well as others, creates a vacuum that forces hostile to our mission, beliefs and expertise will fill. We must define our terms, challenge accepted norms and set a course that embraces the learners and learning technologies of tomorrow. Our language must be more precise as well.

2. THE THINGS WE DO WITH COMPUTERS IN EDUCATION

As computing power becomes cheaper, more portable, more personal and more powerful, school applications seem headed in the opposite direction. The portability, flexibility and decentralization made possible by laptops have been usurped by centralized network-centric models that tether computers to a server and student minds to those who wish to control them.

2.1 Latter Day Drill-and-Practice Software

The market for inexpensive drill-and-practice software evaporated long before the enduring fantasy that if you get the software just right, every toddler will master long division subsided. Today, expensive instructional management systems are sold to poor schools terrorized by the threat of sanctions accompanying low performance on standardized tests. These systems have not changed much in forty years except that they are no longer seen as a window onto the future as much as a life-saving attempt by underprivileged schools. There is a conspicuous relationship between the purveyors of integrated learning systems, textbook publishers and the standardized testing industry. In several cases, all three are divisions of the same large multinational corporations.

These systems embody what Papert describes as instructionism, the philosophy that learning occurs by doing something to the learner. This is a treatment model based on content delivery, regardless and testing prior knowledge. Agency is granted to the machine and its programmers, rather than the learner. Regardless of your view on the efficacy of instructional software, this approach represents just a fraction of the potential offered by personal computers. Preference granted to teaching over learning is common throughout the trends I discuss.

2.2 The Dominance of Information Technology

Educational computing has experienced a semantic sea change over the past fifteen years. In fact, the word *computing* is hardly mentioned in the literature. Educational computing gave way to terms like informatics, ICT, information technology and just technology. When the vast capabilities of computing are reduced to, "just another technology," we are then safe to make comparisons to a zipper or Pez dispensers. Since the widespread deployment of the Internet in

schools during the mid 1990s, the function of the school computer has been reduced to that of information appliance or worse. Contemporary literature, popular and academic, focuses almost exclusively on the use computer for information retrieval and the occasional regurgitation of that information in the form of PowerPoint presentations or web pages. The false complexity associated with designing a web page or slideshow lulled spectators into believing that the students were engaged in an intellectually meaningful activity, when that assumption was not always correct.

Recent doubts about such activities have not led to wide-scale challenges to the practice of digital book reports. Instead a new pedagogy of information literacy has emerged, complete with workshops, workbooks and literature attempting to fortify and justify the use of computers to support dubious educational practices. Edward Tufte, Seymour Papert and very few others outside of the practitioner community, have taken the unpopular step of revealing that this emperor has no clothes. The genuine efforts expended by children creating such products are difficult to disregard, but the context of those efforts and the validity of the task needs to be challenged.

Another unintended consequence of this IT imbalance is the emphasis placed on student research. Actual research in the spirit of the work conducted by historians or scientists is an enormously valuable intellectual enterprise. The process skills associated with authentic research should be a universal part of every child's education. The Internet offers unparalleled opportunities for students to engage in research in ways never before possible, particularly the ability to publish for a limitless audience and engage in collaboration with others across time and space. This is where the majority of the Internet's power as a new learning medium resides. However, schools tend to focus on "looking stuff up," delivering content and monitoring student progress. These uses are not only antithetical to the extraordinary power of the Internet, but their dominance creates unintentional consequences regarding Internet safety, censorship and security.

Simply stated, if the dominant metaphor for using a computer is looking things up, then it should come as no surprise when children look up in appropriate stuff. This eventuality then consumes scarce resources and diverts our attention away from using computers in ways that ennoble a creative and intellectual renaissance in children. The hysteria caused by both fear of using the Internet and the fear of not using the Internet causes schools to employ legions of network managers who are given unprecedented budgetary and educational discretion, along with very little supervision. Teachers wishing to do the "right thing" are often precluded to using the school network in educationally justifiable ways do to policies and technical obstacles created by non-educators with unilateral power.

2.3 The Total Cost of Dependency

I call this phenomenon, the *total cost of dependency* .It relates to the unintended learning costs of over-promising and under-delivering reliable Internet functionality and subsequent benefits. TCOD also applies to situations that result from settings in which the network functions perfectly. Educators accustomed to unreliable network access abandon the use of computers and those lucky enough to have access to fully functional networks too often focus on the use of the Internet to the exclusion of other forms of computing. The popular advertising slogan, "the network is the computer," does not apply to K-12 education.

Proponents of the network-centric view often tell educators that as soon as there is enough bandwidth, everything they ever dreamed of will be possible. There is plenty already possible for learners to do with computers and the fixation on the Internet is depriving too many children of those rich experiences. If there ever *is* limitless bandwidth, computers will be television, not a constructive medium for active learning. For children trying to make a movie, program a robot, animate a poem, build a simulation or design a video game, regular ubiquitous access to a sufficiently powerful computer is far more important to both the job at-hand and a student's intellectual development, than is net access.

2.3 Hooked on Office

A web browser and Microsoft Office are the most used software applications on most computers. This is also true for schools. Both applications represent critical tools for personal productivity and communication. However, learners should also use computers in constructive ways - as an intellectual laboratory and vehicle for self-expression. Adults seem amused by the sight of children playing Donald Trump dress-up, "Look how cute she is! She's wearing mommy's heals and using Excel!" However, the dominance of Office applications in schools places a disproportionate emphasis on using computers to get work done, versus using computers to learn. While the two goals are not mutually exclusive, I assert that the balance of educational experiences should tilt towards learning and process rather than product.

3. WELL MEANING, YET INADVERTENT DISTRACTIONS

Soon after bold creative teachers began tinkering with computers in their classrooms, schools embarked on the well-documented process of assimilating them. Computers were corralled into odd arrangements known as labs and children made an occasional field trip to the lab for the purposes of being taught "computer," often by a teacher possessing few

qualifications. Special computer literacy curricula needed to be developed to meet the needs of inexperienced lab teachers and limited student access. The too often trivial worked done during lab time failed to inspire other teachers to integrate computing into the life of their subjects and motivated teachers were quickly discouraged by too little access to too few computers.

3.1 The Birth of Technology Standards

Nearly a quarter of a century after microcomputers entered schools, the educators, policy-makers and industry organizations responsible for their advocacy faced a growing chorus of criticism. It is simple to conclude that computers did not "work" in schools. Such criticism threatened funding and other forms of non-material support for computing-using educators and something needed to be done. Rather than address the systemic challenges standing in the way of ubiquitous access, too few publicized examples of innovative practice or the creation of compelling models of computationally-rich learning, the educational computing community, led by the International Society for Technology in Education (ISTE)[ii], to create educational technology standards.[iii] The technology standards movement was perfectly timed to coincide with the creation of standards in other disciplines based on escalating demands for accountability from public schools. Unlike disciplines like mathematics, "technology" except in a more vocational form hardly represents a body of study. After all, there are no pencil standards for education.

The creation and publication of ISTE's National Educational Technology Standard (NETs) made ISTE a powerful player in lobbying circles. Yet, for reasons documented elsewhere the NETs are unimaginative, unnecessary and unenforceable. Many of the "standards" are vague and easily satisfied without the use of an actual computer. The authors of technology standards may lack sufficient experience and fluency with computers to make informed recommendations for a more digital generation.

Technology standards are often hypocritical and insulting to the students we serve. Adults speak routinely of how students are so comfortable, competent, fluent and knowledgeable about technology yet we then teach them where to find the enter key as part of a seventh grade keyboarding class. If current and future generations of children come to school with certain technological skills and fluencies, then it is incumbent upon us to build upon their gifts.

Perhaps the most lasting legacy of the NETs is that every state government in the United States, and I suspect elsewhere, were inspired to create even more voluminous technology standards of their own. For example, the American State of Ohio's K-12 Technology Standards are 350 pages long and list 74 authors. Such standards documents fall into the trap of being technocentric – focusing on trivial technical manoeuvres – or inane. A declaration of "children will use a mouse," easily deteriorates into a discussion of the sort of mouse in question – one button or two? With or without a scroll wheel? Has anyone met a child incapable of using a mouse?

Authorship by committee has other pitfalls. The Ohio document requires students to demonstrate that they know how to turn on and off the computer; prioritize and apply appropriate safety measures when working with agricultural and related biotechnologies; calculate quantitatively the resultant forces for live loads and dead loads; identify and explain the tools, controls and properties of materials used in a thermal system (e.g., thermostats, R Values, thermal conductivity); Identify and apply appropriate codes, laws, standards or regulations related to power technologies (e.g., ASHRAE, OSHA, NEC, ISO, Ohio EPA, ANSI); "Describe the tools and equipment you might see on a farm."

A document so broad and verbose easily descends into self-parody. Teachers are frustrated and confused and any reasonable action plan is impossible. Unattainable standards, limited computer access and over-zealous policies result in the fact that most American students touch a computer for just a few minutes per week in school.

3.2 21st Century Skills

Technology standards are often coupled with lofty calls for 21st Century Skills. While some fear the increasingly vocational nature of schooling advocated by powerful corporate lobbying groups, I choose to dismiss the notion of 21st Century skills on other grounds. It seems to me that most of the 21st Century goals advocated by external committees and then imposed upon classrooms are consistent with the values of literacy, citizenship and human development schools have held for more than a century.

My objections to the imposition of 21st Century Skills documents include:

- They are arrogant. Committees of unelected "experts" far away from actual classrooms assemble laundry lists of skills teachers are supposed to teach and assess.

- They are quite similar to 19th Century standards. There is nothing new about educating children to be collaborative, productive, creative thinkers and citizens.

- These standards documents are often nonsensical. An organization, largely comprised of high-tech companies, called the Partnership for 21st Century skills includes the following passage in its standards document.

  > A Nation at Risk also called for computer programming to be included as a "new basic." but since then, the world has gone through a technology revolution. This revolution has led to the need for all students to be technologically literate. Recognizing this, No Child Left Behind requires that students be technology literate by the end of the eighth grade. (Partnership for 21st Century Skills, page 10)

  What does that mean?

- Lists of 21st Century Skills are either written by clairvoyants or time-travellers. Beyond the futility of predicting the future, these documents grant tacit permission for schools to do nothing in the way of changing practice. When you speak of goals for the 21st Century you imply that there are ninety or more years left before any sense of urgency is required.

The fact is that students often surpass these standards without any intervention. Extreme proof of this is presented in Dr. Sugata Mitra's "Hole in the Wall" research. Mitra[iv] placed kiosks containing a monitor, touch screen and high-speed Internet connection in poor communities across India. Within hours groups of children began experimenting with the technology and within weeks students with no formal education and no previous experience with computers could satisfy the requirements stated in most lists of technology standards.

While it is theoretically possible to include challenging performance goals in these standards documents, the nature of standards is standardization. Therefore, the bar for success is kept low and the examples often presented are laughable. Committees of learned instructional designers collaborate on the design of trivial tasks masquerading as exceptional examples. Kindergartners will use Microsoft Office to draw ten geometric shapes; third graders will use a word processor to write long-division word problems; 7th graders will play an online game of pool to learn about angles and ratios represent the sorts of examples offered as models of using computers in the teaching and learning of mathematics. Such instructional tasks should be questionable in pre-computer classrooms, but are now proposed as justification for the use of computers.

4 BABYSITTING THE WEB

4.1 Portals and Other Lists of Lists

The vast nature of the World Wide Web leads some to express concerns about the efficiency of student web research and teachers' lack of time or skill in organizing sites for their students to explore. Wishing to protect students from stumbling upon inappropriate sites is another motivation. While such concerns are admirable, a great deal of attention, energy and money is expended towards the creation of portals, eLearning platforms and filtered categorized lists of web sites. Government agencies use the creation of such sites as a way to maintain control over students and teachers, while publishers can sell these services to schools.

My objections to the list of lists are as follows:

- The need for portals assumes that teachers and children cannot use the web like everyone else.
- The creation of portals assumes the worst of teacher as lazy professionals incapable of using a search engine to identify appropriate sites for themselves or their students.
- Portals replace one unmanageable site with another. As soon as the portal features more than a few dozen sites, it becomes just as unwieldy as any other search engine.
- Portals imply that their author is a trusted authority. The author(s) of portals are unaccountable for their biases or selections. Another assumption is that the trusted authority has a comprehensive knowledge of all of the information on the Web,
- Trusting others to organize your information is sloppy. Only you know what you need.
- Chosen sites are based on keyword search and often very little else. You can find plenty of "I Have a Dream" worksheets under the heading of "Dr. Martin Luther King's Birthday," but probably little to help you understand the man or his life.
- Readability and other classification systems are arbitrary. Grouping content by grade level or narrow curriculum topics eliminates all sorts of authentic learning opportunities.
- Within three clicks of any recommended site on a portal I can find a broken, inappropriate or embarrassingly trivial link.

- Publishing companies should not profit from selling content, by way of links, that they do not own.

4.2 WebQuests

Another school-coloured response to the information age is the WebQuest. Bernie Dodge and Tom March invented the idea in the 1995 as a way of using limited access to networked computers to guide students to find information on the World Wide Web. Bernie Dodge himself admits that the goal of engaging students in challenging higher-order thinking skills is elusive in many WebQuests. Dodge rightfully also acknowledges that WebQuests are often little more than online worksheets leading students to find the dates of the American Civil War after being provided with the URL containing the answer. The very nature of organizing a web-based excursion connecting specific pre-ordained web sites lends itself to instructionism rather than the loftier goals offered by Bernie Dodge. Tools designed to help teachers organize WebQuests tend to favour convenience over the quality of educational experience.

WebQuests trouble me in the following ways:

- Too many WebQuests are the equivalent of online worksheets based on correct answers to questions with one specific answer.
- WebQuests fetishsize the World Wide Web and imply that the best information and resources are online.
- Any curriculum development intended for teachers will ultimately be replaced by content designed by textbook publishers.
- Providing specific web links implies that all of the information you need is found on those few sites.
- The biases and preferences of the teacher
- Most importantly, the WebQuest solves the "Google problem," but Google is not the problem. Teachers and students can and do search the web with little direct instruction. The more experience you have conducting web research, the better you are at it. Millions use Google every day, including our students. Sites do not need be predetermined for most learners or teachers. Literacy, not information literacy, remains an elusive issue for too many students. The old-fashioned literacy skills associated with comprehension, reading for meaning and perspective remain important and are not automatically addressed by participation in a WebQuest.

While it may appear heretical to question the noble motives resulting in technology standards, collections of 21st Century Skills, the theories often result in progress that are less than productive. Without ongoing critical reflective practice and dialogue, unchallenged pedagogical strategies may unintentionally stymie, if not retard educational progress.

I believe that the popularity of portals and WebQuests represents distractions that ignore the knowledge students bring with them to school and is a solution in search of a problem.

5. QUESTIONABLE FADS

It is impossible to predict which specific technologies or pedagogical practices that will withstand the test of time. However, there are several technologies popular in schools that warrant review.

5.1 "Smart" Furniture

Laptops tethered to carts and "intelligent" white boards may seem to be cost-effective strategies for advancing a school's technological capability, but may ultimately reinforce the worst of existing classroom practices. Granting additional value to a teacher lecturing or students having less access to personal computing represent a step backwards.

5.2 Pen/tablet Computing

Computing tablets may turn out to be a fantastic innovation. However, the features touted for education, namely the ease with which students may take notes hardly justify the increased investment over keyboard-based laptops.

Personal computing holds too much promise for liberating the learner for it to be used to validate pre-Gutenberg teaching practices in which students take dictation from "priests" who present it on the board at the front of the room.

5.3 Computer-Shaped Objects and Other Personal Digital Assistants

My fifteen years of work with schools in which every child has a personal laptop computer testities to the value I see in every student owning a personal computing device. However, children often need a more powerful computer than their parent does at work. A learner needs to be able to construct knowledge and express themselves in a variety of

modalities when using a computer. Any computer that allows for this is recommended, especially if it is small, inexpensive, lightweight and supports the imagination of children. However, popular PDAs are not adequate substitutes for full-featured multimedia laptops. They are auxiliary to desktop and laptop computers, but schools have too few of them already.

Most examples of PDA-use in schools are based on note-taking, small document word processing and exchanging small packets of data between teachers and students. There are certainly a few clever uses, particularly in the collection of scientific data, but PDAs, particularly those running the Palm OS have been granted a remarkable level of credibility by the educational computing community. Although such devices have enjoyed little success in the marketplace and excellent applications remain scarce, Palm computers are advocated in a tremendous number of educational publications. Conferences often feature keynote speakers advocating such devices and a growing number of conferences require that attendees own a Palm device in order to read the event program.

The impulse to provide, that which is affordable to the largest number of students, is commendable, but ultimately shortsighted. Asking a funding agency to purchase one of something for everybody is difficult. It is much harder when you realize you made a mistake and have to go ask for another allocation of funds for a more suitable personal computer. Saving your money or finding cleverer funding strategies that allow you to purchase full-featured computers may be a wiser investment of your energy.

5.4 Classroom as Game Show, Teacher as Game Show Host

A new category of products has hit the educational technology market and is enjoying remarkable sales. The more academic-sounding acronym, *classroom performance systems* (CPS), has been created to bestow legitimacy onto the devices. With a CPS, each child watches typically unattractive multiple-choice questions displayed on a screen in-front of them and on-cue punches what they think is the correct answer into a handheld remote-control device. The software can then present the teacher *and class* with the correct answer and a tabulation of student results. Such a system requires learning to be reduced to its simplest, most binary form and gives aid and comfort to the misguided notion that constant measurement is the same as teaching.

Teachers have reported to me that their “colleagues” find it difficult to design their own quizzes for these systems. The result of this difficulty will be that textbook publishers will happily provide, for a fee, questions that require little more than a smile from the classroom teacher. This contributes further to the deprofessionalization of educators and does little to help them embrace the constructive use of computers in their classrooms.

My colleague, David Thornburg, points out that a contestant on “Who Wants to Be a Millionaire” is granted the chance to think about a problem, poll the audience or phone a friend before pulling the trigger on his or her answer. CPS systems prohibit such thinking practices.

5.5 Look at me! Pay Attention!

Perhaps the most disturbing trend in educational technology is the emergence products that equate learning with compliance and unquestioning worship of the teacher. Devices that amplify the teacher so that she is always the loudest person in the room reinforce the notion that the teacher is the source of all knowledge and expertise. If the students are not learning, the teacher can just talk louder. I can only imagine the escalating arms race between teachers in adjacent classrooms when one turns his amp “up to eleven” in order to drown out the colleague next door. The availability of such technology represents the most egregious removal of agency away from the learner and to the teacher.

There are even products that require a student to wear a helmet that alerts them (or the authorities) if the wearer’s eyes leave the computer screen. While this may have application with students suffering specific neurological impairments, I can imagine more nefarious use.

Another device, intended for preschoolers, uses sound and light to alert them of short time intervals in order to begin conditioning them to take standardized tests. The idea is that if you are constantly interrupted in predictable units of time, you will be better prepared to take school tests. The long-term psychological and educational consequences of this device, sold-out during the 2004 holiday season, are yet to be determined.

6. CONCLUSION

> These days, computers are popularly thought of as multimedia devices, capable of incorporating and combining all previous forms of media - text, graphics, moving pictures, sound. I think this point of view leads to an underestimation of the computer’s potential. It is certainly true that a computer can incorporate and manipulate all other media, but the true power of the computer is that it is capable of manipulating not just the

> expression of ideas but also the ideas themselves. The amazing thing to me is not that a computer can hold the contents of all the books in a library but that it can notice relationships between the concepts described in the books - not that it can display a picture of a bird in flight or a galaxy spinning but that it can imagine and predict the consequences of the physical laws that create these wonders. The computer is not just an advanced calculator or camera or paintbrush; rather, it is a device that accelerates and extends our processes of thought. It is an imagination machine, which starts with the ideas we put into it and takes them farther than we ever could have taken them on our own." (Hillis, 1998)

Computers are remarkably flexible devices capable of use in a wide range of contexts. A recent article in Technology and Learning Magazine profiled what the magazine's editors determined to be the ten best returns on school technology investments. Not a single recommendation was something done by a learner with a computer. At the very least, educators and policy-makers should be capable of differentiating between instructional and non-instructional computing. Therefore, of all of the constituencies served by schools, students represent our best investment of resources and imagination. This is a historic opportunity to seize powerful technology to help reinvent the nature and diversity of learning. We should embrace every opportunity to do so by keeping our "eyes on the prize" and avoiding detours. It will be easier to realize the potential of the "imagination machine" if we do everything possible to use computers to afford every learner with rich experiences. An incremental approach to technology integration has borne few fruit in the past quarter century and is later to have a different result in the next. A course correction is in order.

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[i] Kohn has repeated a version of this quip in numerous contexts. One is available online at http://www.edletter.org/past/issues/2000-ma/forum.shtml

[ii] ISTE was formerly called, The International Council for Computers in Education, and its publication was titled, "The Computing Teacher." Its current publication is, "Learning and Leading with Technology." However, without computers playing a central-role, nearly every other technology discussed would be of marginal educational value.

[iii] More on this subject may be read in my article, "The ISTE Problem."

[iv] More information about Dr. Mitra's research may be found at http://www.niitholeinthewall.com/