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The End of Techno-Critique: The Naked Truth about 1:1 Laptop Initiatives and Educational Change

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Educational Outcomes and Research from 1:1 Computing Settings

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This special issue of the Journal of Technology, Learning, and Assessment focuses on the educational impacts and outcomes of 1:1 computing initiatives and technology-rich K–12 environments. Despite growing interest in and around 1:1 computing, little published research has focused on teaching and learning in these intensive computing environments. This special issue provides a forum for researchers to present empirical evidence on the effectiveness of 1:1 computing models for improving teacher and student outcomes, and to discuss the methodological challenges and solutions for assessing the effectiveness of these emerging technology-rich educational settings.

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Shapley, K.S., Sheehan, D., Maloney, C., & Caranikas-Walker, F. (2010). Evaluating the Implementation Fidelity of Technology Immersion and its Relationship with Student Achievement. *Journal of Technology, Learning, and Assessment, 9*(4).

Suhr, K.A., Hernandez, D.A., Grimes, D., & Warschauer, M. (2010). Laptops and Fourth-Grade Literacy: Assisting the Jump over the Fourth-Grade Slump. *Journal of Technology, Learning, and Assessment, 9*(5).

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Abstract:

This analysis responds to a generation of criticism leveled at 1:1 laptop computer initiatives. The article presents a review of the key themes of that criticism and offers suggestions for reframing the conversation about 1:1 computing among advocates and critics. Efforts at changing, innovating, and reforming education provide the context for reframing the conversation. Within that context, we raise questions about what classrooms and schools need to look and be like in order to realize the advantages of 1:1 computing. In doing so, we present a theoretical vision for self-organizing schools in which laptop computers or other such devices are essential tools.

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The End of Techno-Critique: The Naked Truth about 1:1 Laptop Initiatives and Educational Change

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Introduction

After more than a decade of enthusiastic rhetoric (Edwards 2003; Papert, 1993; PITAC, 2001; Stallard & Cocker, 2001) and prolific investment (Greaves & Hayes, 2006) predictable questions (Sarason, 1990) about the educational benefit and effect of 1:1 laptop-computer programs have emanated from numerous sectors (Borja, 2006; Jaillet, 2004; Lei & Zhao, 2006; O'Dwyer, et al., 2008; Schacter, 1999). While many questioners are favorably inclined to 1:1 computing in classrooms, some raise critical issues about laptop-computer usage (Bahrampour, 2006; Bianchi, 2004; Hu, 2007; Vascellaro, 2006), cost (Fitzgerald, 2003; Mowen, 2003), and return on investment (Means & Haertel, 2004; Oppenheimer, 1997; Ricadela, 2008). *Techno-critique* is the label we use to categorize questions, concerns, and issues of this nature.

Techno-Critique

Larry Cuban, a well respected voice – on education reform (1984, 1990, 1998, 2003), educational technology (1986, 2001), and 1:1 computing (2006a, 2006b) – amidst the cacophony of criticism of 1:1 computing initiatives, in many ways epitomizes techno-critique. In "The Laptop Revolution Has No Clothes," Cuban admonishes 1:1 advocates for making "outlandish claims" about "improved learning, better teaching, and students getting higher salaried jobs" resulting from students and teachers having laptop computers (2006a). He charges 1:1 computing advocates with hyping the expectations of technology by confusing the medium (computers) and the message (effect) (2001, 2006a).

Cuban's criticism is twofold. First, he holds that the view espoused by advocates that equipping students and teachers with computers will "revolutionize teaching and learning and, yes, increase test scores" (2006a) is largely unsubstantiated. Second, the advocates' views too often ignore Cuban's belief that achievement gains are more likely to emerge from innovative teaching, including individualized and problem-based instruction (2003), than from the deployment of laptop computers (2006a, 2006b). The first part of Cuban's position appears inarguable. Evidence compiled over the last decade, shows a diminutive effect of 1:1 computing on teaching, learning, and student achievement across schools, districts, and states. A sampling of the evidence from two high profile 1:1 initiatives reinforces that point.

Evidence

First, the Maine Learning and Technology Initiative [MLTI] is one of the highest profile 1:1 efforts. Launched in 2001 with a price tag totaling nearly $120 million, MLTI is the first statewide 1:1 initiative in the USA (McCarthy & Breen, 2001). Numerous researchers have chronicled the progress of MLTI. For instance, Silvernail and Lane (2004) reported that 15 months after 7th and 8th grade students first received their laptop computers "some schools have been more successful than others" (p. 33) in implementing the program. Subsequently, Silvernail and Gritter (2005) reported that for students, "overall performance on the 8th grade Maine Education Assessments (MEA) has not changed appreciably since the inception of the [MLTI]" (p.4). Moreover, among the numerous findings, Silvernail (2007) reported that less than 65% of MLTI teachers used their laptop for "creating and providing instruction" in which they "conduct research for lessons plans", "develop instructional materials", use "presentation software", and provide "classroom instruction" (p. 7). In that study, less than 20% of the teachers strongly agreed that "having a laptop computer has helped me access more up-to-date info" (p. 11) and less than 40% of the same teachers strongly agreed that they "can individualize curriculum to fit student needs with a laptop" (p. 11). According to Silvernail and Buffington (2009), "providing teachers and students abundant access to laptop technology is only the first step toward using the technology as an effective instructional and learning tool" (p. 13).

Second, another high profile initiative is the Texas Technology Immersion Pilot (TIP), a state-sponsored 1:1 computing program in 22 schools, costing nearly $14.5 million (TEA, 2002). Schools in the pilot were part of a four-year evaluation comparing immersion classrooms with control classroom. A range of findings was reported using the *Theoretical Framework for Technology Immersion* (Shapley et al., 2006, 2007, 2009). For instance, Shapley et al., (2009) reported, "Although the overall quality of schools' implementation improved slightly in the fourth year, we estimated that just a quarter of middle schools (6) achieved *substantial immersion* levels, whereas the remaining schools (15) had *minimal* to *partial immersion* levels" (p.80). Shapley et al., also reported that, "Students' access to and use of laptops for learning within and outside of school continued to fall well short of expectations in the fourth year" (p. 88). Moreover, "Evidence from classroom observations suggested that laptop computers and digital resources allowed students in Technology Immersion schools to experience somewhat more intellectually demanding work" (p. 81–82) and that, "Across four evaluation years, there was no evidence linking Technology Immersion with student self-directed learning or their general satisfaction with schoolwork" (p. 83).

Regarding student achievement, as measured by the Texas Assessment of Knowledge and Skills (TAKS), Shapley et al., (2009) reported "Technology Immersion had no statistically significant effect on TAKS reading achievement for [eighth graders] or [seventh graders] – however, for [ninth graders], there was a marginally significant and positive sustaining effect …" (p. 85). Moreover, they found that "Technology Immersion had a statistically significant effect on TAKS mathematics achievement for [eighth graders] and [seventh graders]. For [ninth graders], the sustaining effect of immersion on TAKS mathematics scores was positive but not by a statistically significant margin" (p. 85).

Even though the designs of these studies limit attributions to the role of laptop computers, the general trajectory of their findings make clear that Cuban does not lack support for his naked-truth argument that the results from 1:1 efforts do not match the expectations of their advocates. However, Cuban's other assertion – innovative teaching as the best source for sustainable and scalable achievement gains – exposes a more disconcerting naked-truth about educational change, innovation, and reform. Most efforts to improve education, as many indicate, fail to effect teaching, learning, and achievement across schools, districts, and states (Business Roundtable, 2008; Commission on the Skills of the American Workforce, 2007; Gordan & Graham, 2003; Mortimore, 2006; Noguera & Wing, 2006). In this context, laptop computer initiatives are just the latest attempt to produce such effects.

Naked Truth

If we inserted into the techno-critique argument any one of the long line of previous efforts at changing, innovating, or reforming education, the results would be the same: little or no sustained and scaled effects on teaching, learning, and achievement. That appears to be the case, for instance, with increasing accountability for schools, districts, and states (Elmore & Fuhrman, 2001; Fuhrman & Elmore, 2004), fostering high-performing charter schools (Allen et al., 2009; Zimmer et al., 2009), sustaining comprehensive school reform designs (Aladjem et al., 2006; Comprehensive School Reform Quality Center, 2006), using high stakes tests to drive change (Braun, 2004; Hillocks, 2002; Nichols & Berliner, 2008), professional development (Capuzano, et al., 2009; Darling-Hammond et al., 2009), and increasing academic standards (Harris & Herrington, 2006; Toch, 1996), to name but a few. While researchers have asymptomatically demonstrated the possibility and promise of all sorts of changes, innovations, and reforms, few have shown a symptomatic pathway to improvements in routine practices of teachers and students at scale (Fraser et al., 1987; Hattie, 1992, 2003, 2008). Sparse evidence in the educational literature and in sustained practice shows the existence of innovative, individualized, problem-based instruction or for that matter any other reform or innovation at significant scale across schools, districts, and states. In this context, the argument favored by techno-critics – innovative teaching as the best source for sustainable and scalable achievement gains – is a well-travelled myth.

This phenomenon – many attempts at improvement but few effects – may be due in some part to the implementation problems that have dogged such efforts for generations (Fuhrman et al., 1991; Kirst& Jung, 1991; Kirst & Meister, 1985; Lindblom, 1959, 1990; Weatherly & Lipsky, 1977). If implementation problems (Bardach, 1977) are the cause, then it is surprising that so few studies give empirical attention to that issue (O'Donnell, 2008) and the issue of the gradual wash out of the reforms over time (Berends et al., 2002). A more likely cause is the autonomous, idiosyncratic, non-collaborative, and non-differentiated teaching practices that largely remain uninformed by research about what it takes to significantly improve student learning and achievement (Goodlad, 2004; Lortie, 2002; McLaughlin & Talbert, 2001; Sizer, 2004). Findings from these multi-generational studies are consistent with the research showing "uninspired" (Cuban et al., 2001) use of technology by teachers and students in schools (Bebell, 2005, 2007; Becker, 2001; Gulek & Demirtas, 2005; Kerr et al., 2003; Michigan Virtual University, 2005; Zucker & Hug, 2007; Zucker & McGhee, 2005).

The body of evidence shows that the existence of scalable and sustainable effects from educational changes, innovations, and reforms – technological or otherwise – although frequently assumed remain an unrealized goal within education. In the field's prevailing paradigm (Kuhn, 1996) efforts at improvement, as promising as they may appear, too often are co-opted, diluted, or diminished to generate any widespread effect on teaching or learning. This is the naked and inconvenient truth for the field of education that Cuban and others obscure (Wartgow, 2008).

Ignoring this truth, techno-critics, retreating to presumptions about the power of teachers and schools, have misstated the case. Doing so, they invoke a more pervasive example of a naked emperor in education that in fact, most change, innovation, and reform efforts have been problematic. In education most attempts at improvement were done "to it not by it" (Tyack & Cuban, 1995). Improvement efforts consistently did not attend to what teachers do and value (Cuban, 1998, 2003; Cuban & Usdan, 2003). Not surprisingly, most have done little to change, innovate, or reform education (Noddings, 2007; Pogrow, 1996).

Opportunity

Why single out laptop computers and 1:1 initiatives from other attempts to improve education? May it be that this special treatment has more to do with change, innovation, and reform than with laptop computers and 1:1 initiatives? By missing the forest, techno-critics have diverted attention from the real problem of improving the totality of education for all students. However, for techno-critics, a 1:1 laptop computer initiative is such a visible, expensive, and labor intensive effort that stands out in a forest of reforms. So when a 1:1 initiative fails to deliver the much-hyped results, it is much simpler to start sawing on a tree than it is to cut down the forest and start replanting. But then, like so many problems in changing venerable institutions, it too often is easier simply to protect the status quo and blame the innovation or the innovator.

Ironically, the 1:1 laptop computer initiatives – with their policy mandates, hefty budgets, and far-reaching deployments – may have gone further than most other efforts. Arguably, no other efforts have reached the impact point represented by every teacher and student in a school, district, or state having a laptop computer, receiving training, being evaluated, and getting media coverage. Quite possibly, 1:1 initiatives collectively represent heretofore-unattained scale and disturbance in the equilibrium of classrooms and schools (Dwyer, 2000) and disruption in the educational paradigm (Christensen et al., 2008). And they may have provided a potential foothold for change and a distinct driver for going further.

History suggests that, if this foothold for change is to be expanded in ways that contribute to substantive gains in student performance, techno advocates and critics must take on the big questions about scalable and sustainable change. Doing so requires a new vision for education (Fullan, 2007) and technology that includes the capacities and functionalities that laptop computers and 1:1 computing afford (Kolderie & McDonald, 2009).

New Vision

Bransford et al., (2000), Jonassen (2000, 2004, 2006, 2008), and Jonassen et al., (1999) fix the future of educational technology in *cognitive tools* that shape and extend human capabilities. Cognitive tools blur the unproductive distinctions that techno-critics make between computers and teaching and learning (Bullen & Janes, 2007; Hukkinen, 2008; Kommers et al., 1992; Lajoie, 2000). When technology enables, empowers, and accelerates a profession's core transactions, the distinctions between computers and professional practice evaporate. For instance, when a surgeon uses an arthroscope to trim a cartilage (Johnson & Pedowitz, 2007), a structural engineer uses computer-assisted design software to simulate the stresses on a bridge (Yeomans, 2009), or a sales manager uses customer-relations-management software to predict future inventory needs (Baltzen & Phillips, 2009), they do not think about technology. Each one thinks about her or his professional transaction.

No equivalents of these technologically enabled transactions – surgery, designing, or forecasting – exist within the prevailing educational paradigm or 1:1 computing models. What does exist are replacements: books replaced by web pages, paper report cards with student information systems, chalkboards with interactive whiteboards, and filing cabinets with electronic databases. None of these equivalents addresses the core activity of teaching and learning. Each merely automates the practices of the prevailing paradigm (a) non-differentiated large-group instruction, (b) access to information in classrooms, (c) non-engagement of parents, and (d) summative assessment of performance (Weston & Brooks, 2008).

Advocates of 1:1 computing who engage in such replacement exercises use the tree to hide the forest. They believe that educationally beneficial uses of computers will emerge spontaneously from the deployments of laptop computers in ratios of one computer per user. In other fields, this has not been the case. Form and function of usage have driven access to computers, not vice versa. Educators should think similarly.

Discussion

Consider a school where teachers and students have cognitive tools. In that school, we should reasonably expect to see educational practices that have been transformed by technology that accelerates (Collins, 2001), differentiates (Tomlinson & McTighe, 2006), deepens (Herrington & Kervin, 2007), and most importantly maximizes the learning experience of all students (Darling-Hammond, 2008; Slavin et al., 2001). We should also expect that teachers reflect the transformation through their highly valued and complete knowledge and skill of specific research-based practices such as cooperative learning (Slavin, 1995), differentiated instruction (Tomlinson, 2009), and problem- or project-based learning (Lambros, 2004). Each practice has been proven to make dramatic learning gains possible for all students (Bloom, 1984a, 1984b; 1988; Marzano, 2007; Marzano & Kendall, 2007). Moreover, cognitive tools would be expected to help teachers design, deliver, and manage those proven practices in ways that are sustainable and scalable (Jonassen, 2006, 2008). The result is a school full of classrooms that are differentiated in genuine ways for all students, with teachers who gather and mine just-in-time data about the effects of differentiation for each student. Further, students, parents, and teachers use the cognitive tools every day to collaborate about what to do next in their collective pursuit of learning. For them, waiting passively for the results of the big, once-a-year standardized test is not an option. That is why, if asked about the value of using a laptop computer in school, each would struggle to see the relevance of such a question because computers have become integrated into what they *do*. They have become incapable of thinking in the old binary worldview of medium and message that techno-criticism sustains. In short, the paradigmatic gestalt (Kuhn, 1977) of teachers, students, and parents has shifted such that each has a holographic vision (Senge, 2000) of what *school* means (Fullan, 2005). Collectively they have a *schema* (Marshall, 1995) for being a transformed teacher, student, school leader, or parent working in a transformed school. In their view, laptop computers are not technological tools; rather, they are cognitive tools that are holistically integrated (Senge et al., 2005) into the teaching and learning processes of their school (Bain, 2007).

Realizing the Benefit of Cognitive Tools

The central and prerequisite question here concerns educators and schools capable of sustaining and realizing the benefit of cognitive tools. How must they differ from the educators and schools that are now struggling with 1:1 computing (Bain & Weston, 2009)? A viable answer to this question will have a least six components.

One, the community comprising the school – students, teachers, school leaders, and parents – must have an explicit set of simple rules (Bain, 2007; Seel, 2000) that defines what the community believes about teaching and learning. The rules and the process of building consensus about them, assign value to what the community believes (e.g. cooperation, curriculum, feedback, time). The rules are not a mission statement; instead, they are the drivers for the overall design of the school and the schooling that occurs therein (Weston & Bain, 2009).

Two, the school community deliberately and systematically uses its rules to embed its big ideas, values, aspirations, and commitments in the day-to-day actions and processes of the school (e.g., physical space, classroom organization, equipment, job descriptions, career paths, salary scales, curriculum documents, classroom practice, performance evaluation, technology, professional development). Embedded design yields a complete picture, absent of the broad, loosely coupled (Weick, 1976) brush strokes and sweeping references to "best practice" (Daniels et al., 2001) or "excellence" (Peters, 2009) that characterize techno-critique and are common in most approaches to educational change, innovation, and reform.

Three, all members at all levels of the school community are fully engaged with creating, adapting, and sustaining the embedded design of the school. Each member is an active agent – not a consumer or provider – in the processes comprising the community's design. For instance, students have clearly articulated roles, responsibilities, and performance measures instead of expectations for just being good citizens. Each student understands what constitutes effective cooperative and peer-assisted learning and can act skillfully with that knowledge.

Four, the embedded design generates feedback from all members of the school community: teachers, school leaders, students, and parents. Feedback occurs real-time all of the time. It reinforces what works and dampens what does not (Gell-Mann, 1994; Johnson, 2001). Thus, every community members is accountable in ways that are a by-product of the real purpose of feedback – enabling every member to know and understand what must happen next in order to consistently and contiuously affect learning positively. Feedback drives bottom-up change and makes the community capable of charting its own course absent constant top-down intervention.

Five, the interplay of rules, design, collaboration, and feedback make it possible for the school community to develop an explicit schema—a shared conceptual framework for practice—that defines interactions for the community members in their pursuit of learning (Marshall, 1995). Their schema exists at the level of the school as opposed to being idiosyncratically constructed over and over by individual teachers acting in isolation, doing ad hoc work, and behaving idiosyncratically. The schema is not static, however. It is fuelled by constant feedback; making the school dynamic, ever changing, and *self-organizing* (Bain, 2007).

Six, guided by their use of their schema, community members demand systemic and ubiquitous use of technology, as opposed to idiosyncratic and sporadic use of technology described in the research on many 1:1 computing programs. Communities that ascribe to these components are able to build cognitive tools that reflect their pedagogical and curricular values at the scale of a school, district, state, and beyond. Such tools help members design and deliver curriculum, manage portfolios, enable research, inform classroom practice, gather and share feedback about practices and processes, engage parents, and more (Bain & Parkes, 2006; Bain, 2004).

When the six components are in place, the cognitive tools they form and reinforce help reconcile the unique capacities that each member brings to the community with the professional knowledge of the school and the field. In sum, the cognitive tools help members to teach, learn, create, communicate, and deliver feedback. In schools with cognitive tools, teaching, learning, and technology are more than blurred. They are integrated, and they are inseparable. No question arises about getting teachers to "use the computers." With the practice of teaching and learning so deeply embedded in the rules, design, collaboration, schema, and feedback processes of the school, its capacity to function is only possible using those tools. When a school reaches this point, it is a self-organizing learning enterprise (Bain, 2007).

In a self-organizing school, if the community members want it, all students can have differentiated learning experiences that produce measurable and substantial academic and social effects. The effects occur in multi-dimensional ways. Feedback makes it self-evident. The opportunity to adapt instruction based on that feedback makes profound learning gains attainable. Such gains, most will agree, are unattainable within the existing educational paradigm and 1:1 computing programs. They are only possible when technology, in the form of cognitive tools, aids in the gathering, sharing, and managing of feedback and adapting instruction in ways that enhance instruction and improve learning.

In the pursuit of changes, innovations, and reforms that improve education, 1:1 initiatives need not be the naked problem described by techno-critics; rather, 1:1 initiatives can be fertile ground for the creation of new-paradigm schools, schools that are self-organizing. The widespread availability of laptop computers can be a driver for the more expansive efforts that must happen in order for schools to meet the educational needs of all students. School communities, by adopting a self-organizing vision, could contribute to the arrival of a new paradigm for all of education. While the original mission of 1:1 laptop computer initiatives did not include shifting the educational paradigm, turning those initiatives toward the creation of self-organizing schools may be the best way forward for techno advocates and critics alike. Realizing this unique opportunity requires that both see the same – but a very different – forest.

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