

Understanding the Technologies of Our Learning Environments

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We all know how difficult it is to change any aspect of an organization when there is not general agreement about the goals and objectives of the change; but what is it about the ways we have organized ourselves in educational institutions that makes it so difficult to implement changes even when we all agree on the need for the changes? I have worked for more than twenty-five years in education — at both the K-12 and higher education level, and from both inside as a teacher and administrator and from outside as a consultant — and I have spent much of the last fifteen years working on the design and implementation strategies of technology solutions for education, government and business organizations. Until recently, however, it remained a mystery to me why much, if not most of the technological change in educational institutions either failed completely or took seemingly forever to effectively implement — *even when everyone at the institution wanted it to happen.*

Several of the areas of research being conducted as part of the NSF-funded H.E.R.N. project¹ have thrown some light on this problem and I will discuss in this article the working hypothesis that much of the resistance to technological change in our educational institutions, as well as to change of any sort, is due to interconnected structural elements of organizations which remain for the most part invisible to us in our planning and implementation efforts.

A Fish Out of Water

Our children come into our schools today Sesame Street-wise, Sega-circuited and MTV-literate. They have watched thousands of hours of television and spent hundreds of hours playing electronic games even before they come to kindergarten. They get 50% to 75% of their information from video and graphical sources. They are comfortable with technology. They grew up with it. It is the learning environment within which they have had the majority of their experiences. And we as adults, as parents,

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¹ The *Hawaii Education & Research Network* (HERN) is a cooperative research effort of the University of Hawaii and the Hawaii Dept. of Education to investigate the impact of on-line information technologies — in particular, the Internet — as an impetus to or accelerant of school reform. HERN is a three-year national demonstration project funded in part by the National Science Foundation under its Networking Infrastructure for Education initiative.

have provided them that environment and, for the most part, left them on their own to explore and interpret it prior to entering the school system.²

And then we send them into our schools, where 80% to 90% of the activities are still text-based activities. We take them out of the rich, multi-mediate environments of the homes and neighborhoods in which they have become interactively “literate” with their world and put them into the functionally mono-mediate environments of most classrooms and libraries where we attempt to dumb them down to what Seymour Papert³ has called “letterate” learners. The image that comes to my mind is that of a fish swimming easily and gracefully in the visually and graphically rich waters of the electronically over-stimulated environments outside of our educational institutions and, from 7:30 AM until 2:30 or 3:30 PM every weekday, that fish is pulled out of these familiar waters and thrown onto the dry dock of academia to flop around out of its element until, at the final bell of the day, it is thrown back into the waters of the electronic world where it promptly heads off to an electronic game parlor or Internet cafe to resuscitate itself!

The response to this disparity has taken, as one might expect, two major tacks. The camp which has been growing rapidly in recent years and includes academic types such as MIT professor Seymour Papert and author/futurist Alvin Toffler, as well as such diverse political bedfellows as Newt Gingrich and the Clinton/Gore administration —

There are thousands of buildings in this country, with millions of people in them who have no telephones, no cable television and no reasonable prospect of broadband services. They are called schools.⁴

— has argued for making the schools more like the world they inhabit. Another camp, smaller but increasingly vocal and represented by academic types such as journalist Bill McKibben⁵ and educational psychologist Jane Healy,⁶ as well as politicians such as William Bennett and the political arm of the so-called “religious right”, argue for changing our lives and the world we live in to make them more like the schools our kids attend.

I will gladly admit to being a card-carrying member of the former camp. But not because I think our schools should mirror the mindless electronic cacophony that characterizes the media-driven environments in which we live much of our lives; rather, I subscribe to the “change the schools” camp because we must start to teach from where our children are prepared to learn and we must prepare our

² Even after they enter the school systems, we leave our children largely on their own to explore and interpret their experiences of the real and fictional worlds served up by the electronic media. There is very little being done in most schools to create electronic media literacy.

³ Seymour Papert, “Literacy and Letteracy in the Media Ages,” *Wired*, May/June 1993, pp. 50-52. See also Seymour Papert, *The Children’s Machine: Rethinking School in the Age of the Computer* (New York, NY: Basic Books, 1993)

⁴ Reed Hundt, Chairman, Federal Communications Commission, in a television interview in 1994.

⁵ Bill McKibben, *The Age of Missing Information* (New York, NY: Random House, 1992)

⁶ Jane Healy, *Endangered Minds: Why Our Children Don’t Think* (New York, NY: Simon and Schuster, 1990)

children to live in a world which very likely will become more, not less, of an electronically determined virtual experience.

Both sides of the argument point to recent research which shows that the brains of children raised in information environments increasingly dominated by the electronic media that characterize most of our homes are simply “wired” differently. In a talk given in Honolulu in 1993, Jane Healy noted that:

Kids today are different cognitively. Their brains have been shaped by a culture that makes it harder to teach them and to accomplish the same curriculum that was possible ten to fifteen years ago.⁷

But then she went on to argue, as does McKibben in his book, that the solution to this is to turn off the televisions and the computers, take away the Sega and Nintendo gameboards, and spend more time reading, singing, dancing and walking in the woods. As an avid reader and hiker (but a very poor singer and dancer!), I am all for spending time reading and strolling in the forests; but, as a parent watching my daughter grow up in the real world, I know that preventing a child from interacting with the primary technologies of today’s world will simply guarantee that she will end up functionally illiterate. Trying to isolate her from electronic media is tantamount to teaching her to ride a horse instead of drive a car when she turns sixteen.

If the current research concerning the development of the brain and consciousness⁸ is correct, then we must start from where our children are in their ability to learn in order to teach them anything at all. Even if our goal is to simply convert them from multi-mediate “literate” learners to mono-mediate “letterate” learners, then, at the very least, we need to begin their deprogramming with the technologies they are familiar with and gradually move them toward the technologies with which most of my generation is comfortable. And certainly, if our goal is to prepare them to lead personally valuable and socially productive lives in a world which I increasingly believe will be very much like the one described in William Gibson’s 1984 cyberpunk novel, *Neuromancer*⁹, then we must educate them to a multi-mediate literacy which will give them the critical awareness needed to deal effectively with the full range of electronic media which seeks so desperately to shape and control their perception of reality.

Invisible Technologies

So what is the problem? The majority of educators I talk to recognize the disparity between the living environments of our homes and neighborhoods and the learning environments of our schools. Most

⁷ As reported in *The Honolulu Advertiser*, March 28, 1993, p. A-11. I will restrain myself from commenting on the notion that anyone would want “to accomplish the same curriculum that was possible fifteen years ago” even though I know from experience that the textbooks in many schools are that old if not older.

⁸ See for example a recent article in the February 19, 1996 issue of *Newsweek* magazine entitled “Your Child’s Brain” (pp. 52-62) which argues that the neural infrastructure which determines both how and how much a child can learn is largely completed by the age of three or four years.

⁹ William Gibson, *Neuromancer* (New York, NY: The Berkeley Publishing Group, 1984)

of them agree that schools need more technology to close this gap and that current curricula need to be updated to reflect both the learning consciousness of today's students and the largely electronic content of today's social and cultural environments.

When I went to work as an Asst. Superintendent for Information Technology in Hawaii's statewide school system, I was told that I would find things to be very different in the K-12 education environment than I was used to in the GTE corporate environment. My biggest problem, I was told at the state and district level, would be the resistance of the teachers to using technology in the classroom. But, when I talked to most classroom teachers, the majority of them told me that they couldn't wait to get computers and video cameras into their classrooms. And, when the T³ technology training program was started in 1993 it was consistently oversubscribed in spite of its demanding curriculum.¹⁰ When you ask the teachers what is holding things up, they point to "old fashioned" or "stingy" school and district administrators and "know-nothing" parents who refuse to invest in the technologies necessary to bring their classrooms into line with the "real world" that exists outside of the campus.

The administrators I talked with, on the other hand, blamed either "technology resistant teachers" or the lack of funding for technology. In view of the findings noted just above, I shall pass over the problem of "technology resistant teachers" and focus on the second problem: lack of funding for technology in schools. The major issue here is that, for most educators, administrators and teachers alike, the term 'technology' has come to be identified with computers. When I was able to sit down with school technology planning groups and go over their school budgets, I would try to point out how much money the school was actually spending on "technologies" in the broad sense of the term — i.e., the money they were currently spending on:

Paper, Pencils, Chalk, Blackboards, Whiteboards, Magic Markers, Filing Cabinets, Televisions, Radios, VCRs, Books, Tests, Filmstrips, Videotapes, Overhead Projectors, Tables, Desks, Chairs, Maps, Magazines, Cards, Stamps, Shelves, Clips, Cans, Boxes, Balls, Bats, Baskets, Paints, Pianos, Horns, Clay, Dishes, Spoons, Forks, Knives, Glasses, Cups, Clothes, Costumes, Makeup, Clocks, Watches, Lights, Pipes, Sinks, etc., etc., etc.

The fact is that most schools do not have any funds for technology because they are spending all of their money on technology! More precisely, schools spend so much money on older, industrial age technologies, that there is little left for investing in the newer information age technologies.

The reason this escapes most of us is that these older technologies have become so much a part of our everyday living and learning that we no longer consider them to be "technologies" at all; they are

¹⁰ The "Technology and Telecommunications for Teachers" (T3) program is a ten-month certificate program to train in-service teachers to be school technology coordinators. Since 1993, cohorts of 60 to 100 classroom teachers have participated in the 15-credit, graduate certificate program jointly offered by the University of Hawaii (UH) and the Hawaii Department of Education's (DOE) Hawaii School Leadership Academy. The program requires them to attend classes for four hours every Tuesday and Friday evening from mid-August to mid-May with numerous full-weekend sessions along the way. The program is offered statewide to multiple sites using the UH/DOE interactive distance learning television and Internet services networks.

simply the “environment” within which we live and learn. They are, for the most part, invisible to us and, as such, the roles they play in both enabling and constraining our activities go largely unnoticed and unevaluated. The newer, unfamiliar technologies of the information age — which are for the most part an invisible part of the living and learning environments of our children — stand out to notice and evaluate: “They are too expensive.” “They are too difficult to learn to use.” “There is no place to put them.” “There is no money to take care of them.” etc., etc.

This is, however, but the tip of the iceberg when it comes to invisible technologies. The majority of the “technologies” which enable and constrain our ability to reform organizational behaviors, restructure institutional policies and procedures, and renew academic curricula operate as an intricately interlinked series of conceptual “boxes” in which we have placed ourselves. We have done so consciously and for good reason at the time we created them, but we have for the most part forgotten about these boxes and left them to invisibly bewitch and torture us. Let me mention just a few.

Learning Spaces

101	102	103	104	105	106
Office	Library	110	109	108	107

Most classrooms and offices in most schools are physical boxes, usually sized for 20 to 40 students and one teacher. The cost of removing or modifying these fixed (usually concrete) walls prevents most administrators from even thinking about restructuring their learning environments to accommodate larger or smaller learning groups. Placement of windows and doors, as well as minimal availability of electrical and telecommunication infrastructures in most spaces make the task of re-engineering existing schools for new information technologies almost as expensive as starting over and building a new facility. And, since many architectural and engineering firms have yet to discover, much less adopt, the principals of “smart building” design, the majority of the new schools being built today still do not include “voice,

data and video to every wall of every room in every building” as a standard design specification for the information utility infrastructure.

I still get asked by architects and engineers why I would want to “waste so much money putting all of that infrastructure in place when it may never get used.” That the electrical outlets these same architects and engineers religiously place every six feet along every wall of every building as part of the electrical utility infrastructure for a building may likewise never get used does not occur to them. Electrical outlets and lighting have become part of the standard building environment. They are invisible to both the designers and the users of the building. No architect ever asks his client anymore, “Do you think you want lights and electrical power in this room?” It is a given. Even in the janitor’s closet.

And someday, so shall it be for the information utilities in our schools. But not just yet and, as a result, this largely invisible “architectural box” constrains our efforts to reform education.

Learning Schedules

	Mon	Tues	Wed	Thur	Fri
First Period					
Second Period					
Third Period					
Fourth Period					
Fifth Period					
Sixth Period					
Seventh Period					

So too is it with the learning schedules which dominate the days and weeks of most schools. Somehow the 50-minute period has come to define the time of a normal learning event. It makes it easier to track the “seat time” required of most students to meet the standard, input-oriented graduation requirements. Fifty minutes is also about the right amount of time to “cover the material” in a standard chapter of a standard textbook. They fit each other. They reinforce each other. But such structures make

it very difficult for one teacher or a group of teachers to try something new, like teaming up to play SimCity, SimLife, or SimEarth all day, every day for a month to see which group can research, design and build a sustainable living environment. Short of creating a “school within a school” — which many innovators have tried — learning events which require more than 50 minutes are very difficult to schedule, manage, evaluate, and accredit. And so these “scheduling boxes” continue to invisibly assist in the prevention of change.

Learning Frameworks

And just as the “boxes” of typical learning spaces and learning schedules invisibly constrain the places and times of learning events, so also do learning frameworks divide up the experiential content of learning into unrelated events and artificial groups. We move our children out of integrated families and neighborhoods of multi-aged individuals where they learn from intricately inter-related, multi-mediate, comprehensive experiential events into school “classes” where they are artificially grouped by age with little or no attention to ability, and where they learn to understand their holistic experiences in terms of largely unrelated, conceptual structures artificially and, for the most part, temporarily grouped together into academic disciplines.

	Math	Science	English	Social Studies	Health
First Grade					
Second Grade					
Third Grade					
Fourth Grade					
Fifth Grade					
Sixth Grade					
Seventh Grade					
Eighth Grade					

Although most Americans decry the existence of “classed” societies such as those found in India and, until recently, South Africa, they blindly send their children off to schools which have organized their

internal mini-societies and learning events in just this same unreasonable way. And we do so because the technologies of curriculum frameworks have become just one more set of invisible boxes which are part of our learning environments.

Learning Assessments

Of course, if we have carefully “boxed” every aspect of the delivery of our learning events, we will want to make sure that we have appropriate boxes for the evaluation of the results. And so it is that the multitude of testing and evaluation technologies we employ in education almost guarantees that any deviation from the standard educational delivery technologies will result in lower test scores for students and, as a result, for the schools those students attend. The fear of media-hyped “Test Scores Fall; Schools Fail Again” headlines write large across the front page of the morning newspaper or shouted as the lead story on the evening news works very effectively to keep most would be innovators in line.

**SAT
ACT
IQ
GRE
GED**

RIP

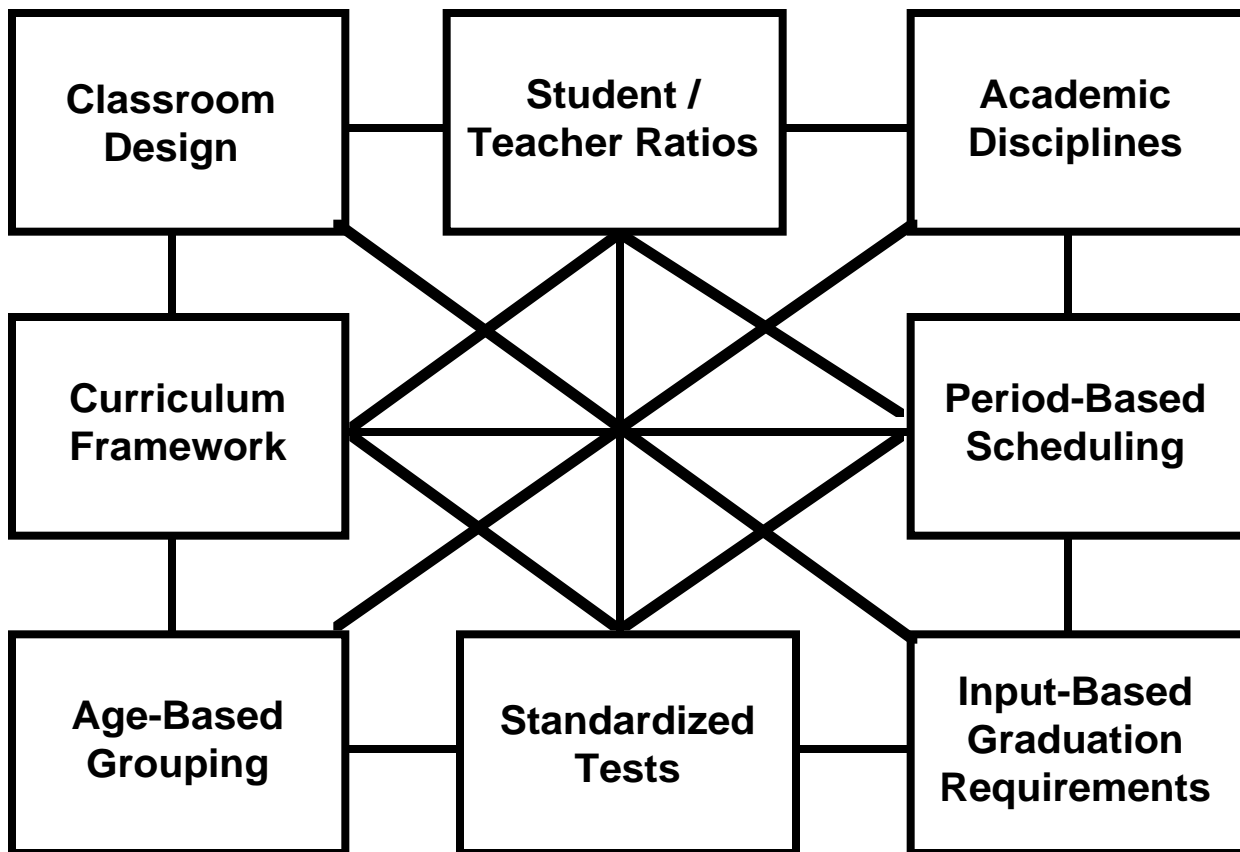
Quartiles	Stanines				
	I	II	III	IV	V
Fourth Quartile	60%	70%	80%	90%	100%
	10%	20%	30%	40%	50%
Third Quartile	60%	70%	80%	90%	100%
	10%	20%	30%	40%	50%
Second Quartile	60%	70%	80%	90%	100%
	10%	20%	30%	40%	50%
First Quartile	60%	70%	80%	90%	100%
	10%	20%	30%	40%	50%

The above graphic is, of course (and perhaps very appropriately), representative of nothing any respectable testing authority would produce. In spite of repeated public pronouncements by the various testing agencies that the myriad of tests and evaluations to which we subject our children in schools does not represent what they may know or how intelligent they are, but rather only measures their responsiveness to the sundry structured learning events — read “boxes” — employed by that school, the public in general and the media in particular continues to insist on judging the viability of our students and

the quality of our schools by the results of these tests. And so yet another largely invisible technology exercises its constraining influence over curriculum reform and school restructuring.

“You Can’t Ever Get Enough of What You Don’t Really Want.”

This famous quip from the philosopher Eric Hoffer provides a good summary for my concluding observations. To push my “boxes” metaphor a bit further, imagine a cardboard box with the flaps on both ends open. Such a box is rather flexible. It can be laid flat, made into a cube or even a diamond shape. It can be changed, at least in some ways, with very little effort. But, if we close up and interlock the end flaps and/or tape them together with strapping tape, then it is a very different story. The box has become strong but inflexible, perhaps even sturdy enough to bear the weight of our standing upon it. It does not easily let us change its shape or purpose, unless we crush it and thereby make it largely useless.



Creative teachers and administrators might find innovative ways to overcome the constraining influences of any one of these invisible technologies which dominate the learning environments of our schools. But the combined, interlocked power of these learning technologies is almost invincible, even more so because they are hardly ever recognized and taken into account in the normal planning processes

of most schools. Our most inspired and innovative efforts to change our learning environments often fail for reasons we do even understand.

This is not a problem only of the public sector of education; it characterizes the independent schools as well. And it is not even a problem unique to educational institutions; corporate organizations, large and small, suffer under their share of invisible technologies as well. The difference perhaps is that when a business fails in its planning to fully recognize and deal with all of the “technologies” — both visible and invisible — which influence and structure its operating environment, it is in danger of ceasing to exist.¹¹ Educational institutions, as well as most government entities, seem to be able to survive while avoiding change for considerably longer periods than most businesses. For the most part this is accomplished, in my opinion, by the allocation of an ever increasing share of the institutional or government operating budget toward the justification and defense of the status quo until such time as the entity is either financially or functionally bankrupt. At this point it ceases to exist, is replaced, or executes the required changes in a crisis environment — usually under new management.

As I noted earlier, most of those involved in education — teachers, administrators, unions, board members, legislators, parents, and students — recognize the need for bringing our schools more into tune with the technological realities of the communities they serve. I have met no one in any of these groups who operated in bad faith, intentionally seeking to misfit our children for the future in which they must live and work. There may be some disagreement about what that future may (or should) be, and there are a few, perhaps, who long for — and work to restore — some remembered golden age of learning that likely never existed in reality. But there has been no one who wished for our schools and their students to fail.

We have all conspired in one way or another, either consciously or unconsciously, to create the multi-mediate, and increasingly electronically mediated, environments that characterize the homes and neighborhoods in which we are raising our children. The task which confronts us as educators is now to create, very consciously and cautiously, a similar technologically-rich and media-literate learning environment for our schools — if indeed this is where the learning environments of the future will be located. To do this, we must learn to recognize all of the technologies which enable and constrain our learning environments, both the most obvious and the almost invisible ones. And the key question which needs to be answered in beginning this process is not “What is the role of information technologies in schools?” but rather “What is the role of schools in the age of information technology?”

¹¹ The well-known management consultant, Tom Peters, is fond of threatening successful business executives with the observation that, in any given ten year period, somewhere between 40% and 60% of all Fortune 500 corporations will disappear as businesses — not just fall out of the Fortune 500 but, in most cases, simply cease to exist! And it is usually because they either did not recognize the need to change or, recognizing it, were unable to transform themselves into the new organizations that they needed to become in order to survive and prosper. See Tom Peters, *Thriving On Chaos: Handbook for a Management Revolution* (New York, NY: Alfred A. Knopf, 1987) and also Peter Drucker, *The New Realities* (New York, NY: Harper & Row, 1989)

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