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It just doesn't compute

How the big push to put computers in schools can actually harm our kids

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At a Toronto school, parents voted to spend thousands of dollars to buy networked computers for the primary classes. When a parent questioned the objectives behind the decision, he was told by another parent: ``I'm a judge, and all the judges have computers."

It's a typical story that underlines how computers are now regarded as education's biggest shot in the arm. We, as taxpayers, are spending huge amounts of money for the machines and their elaborate software programs. More important, we're investing our hopes for our kids in them.

Are the spending, and the hope, badly misplaced? In a new book, The Child And The Machine, Alison Armstrong and Charles Casement

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conclude that they are - and that computers are putting our kids' education, and even their health, at risk.

Following are parts of their book, published by Key Porter Books. It will be in stores on Sept. 19:

By Alison Armstrong
and Charles Casement

DO COMPUTERS really enhance learning? The public sees them as a passport to success, but is there consistent and convincing evidence to support this?

The answer is far from clear.

Computer-based schooling may lead to better results on standardized tests, but this does not necessarily reflect the quality of students' learning. Test scores are a narrowly based form of assessment and do not reflect the over-all quality of students' academic performance.

But that has not deterred the wholesale belief that computers are the fix our education system needs. Vast sums of money are being spent to integrate a technology whose benefits are unproven and in many respects counter-productive.

Research into the link between computers and improved academic performance has been going on for more than 30 years. The results are inconclusive and inconsistent at best.

For example:

Researchers at the Centre for Research on Learning and Teaching

at the University of Michigan found that in 254 controlled evaluation studies, computer-based instruction ``usually produces positive effects on students.'' The average student in a class receiving computer-based instruction would outperform 62 per cent of students in a class not using computers.

But a two-year study of some Minnesota school districts found Grade 4 to Grade 6 students who used computers did slightly less well in math, reading, and language arts than students taught by traditional methods.

And researchers from Florida A&M University and Florida State University reviewed a number of studies and found no significant difference in performance between students who were using computers and those who were not.

Of course, even where the results were positive, not all students benefited equally. Boys appeared to perform better than girls; low-achieving students showed more improvement than average students.

So-called Integrated Learning Systems (ILS), where computers programmed to be part of the standard curriculum act like electronic workbooks, show similarly unconvincing or problematic results.

A frequently cited advantage of ILS is that it allows students to work at their own pace by presenting the lesson according to the level each student has reached. The computer provides immediate feedback to the user and records the student's work for later inspection by the teacher. By

monitoring the results, teachers are supposed to be better able to assess where their students need assistance.

It appears, however, that ILS programs have had only moderate success in improving students' academic achievement, and in some cases their effectiveness has been exaggerated.

In New York City, for example, an ILS project that ran from 1989 to 1993 and involved thousands of students in Grades 3 through 5 failed to produce the expected improvements in math and reading. The results ``were at best mixed and at worst negative,'' researchers found.

One of the problems, says Henry Jay Becker, of the University of California, is that Integrated Learning Systems lack human interaction. The learning environment they provide ``is individualistic and solitary at its core.''

But childhood learning is primarily a social activity. Young children especially learn at least as much from talking with their teachers and with other students as they do by solving problems on their own.

With self-paced ILS instruction, it is conceivable that a child could be working at a different rate on a different program than her classmates. What opportunity, then, to share problem-solving strategies?

Even where the use of computers appears to improve students' academic performance, there is reason for caution.

Most research studies take place over a relatively short period. Gains made in, say, three months may merely reflect the circumstances of the study. In that case, students' increased interest and motivation would be in response to the attention lavished on them by the researchers and the novelty of using computers.

THE UNIVERSITY of California's Becker cites evidence that the enthusiasm with which students start ILS learning soon begins to wane, despite the games and graphics. Once using a computer becomes routine, students find that they have no real control over what they are doing and that much of what they are required to do - drills and practice - is dull and repetitive.

This puts into perspective one of the most persistent beliefs surrounding computer technology: that this technology helps motivate students in all areas of the curriculum.

Many teachers and parents are convinced the computer can propel children into learning a wide variety of skills. Since the degree to which children are motivated to learn is an important factor in determining how well they do in school and since children often appear to be completely absorbed when using a computer, it is easy to believe computers have a positive influence on all aspects of their learning.

But while children may quickly warm to the technology, there is no proof their enthusiasm spills over into other areas of learning.

Another persistent belief - particularly powerful in a climate of fiscal

restraint, where there is a growing pressure for accountability and measurable outcomes - is that the computer is an ideal means of objectively measuring student achievement.

But, in fact, not only does computer technology work better for some students than for others, it also cannot come close to accommodating the wide range of learning styles that are evident in any classroom and the range of talents or needs represented in every student.

Why, then, hasn't there been more public debate about the limitations of computer-based instruction?

The simple answer seems to be that there is a bias in what gets reported. Positive results get more attention.

Companies that produce and market educational computer programs conduct and publicize the results of their own studies, which tend to place their products in a favourable light. Discussion of research studies that are critical of computer-based instruction seldom makes its way into the mainstream media.

While the hype is so blatant that it is often difficult to separate journalism from advertising copy, the belief that computer technology will transform education is so widely held that few have questioned the extensive claims made for it.

Computers and standardized tests together seem to be an unbeatable combination, the inevitable solution to getting North American education on track. But each in its own way truncates a student's learning

opportunities.

The rationale for standardized tests is that they measure students' ability to do well in school. However, high test scores are not related to the depth or scope of students' learning, but merely to their test-taking ability. Standardized tests measure how well students are likely to do in subsequent tests of a similar nature.

The origins of standardized testing go back to Sir Francis Galton, a cousin of Charles Darwin and creator of the infamous ``bell curve.'' In 1869, Galton published a book called Hereditary Genius, in which he hypothesized that one could measure the degree to which people differed from one another in intelligence. He devised a way of representing the distribution of intelligence among a given population by constructing a curve, based on a purely imaginary scale, which showed that 50 per cent of individuals would fall within the middle (normal) range, the remainder being divided equally among those of lesser or greater intelligence. The curve that resulted was in the shape of a bell.

Galton assumed, then, that intelligence could be measured on a linear scale and that such measurement would result in a bell-curve distribution. These assumptions were based on no scientific proof whatsoever.

Intelligence and achievement tests are designed to produce scores that will conform to the bell curve. In other words, their level of difficulty is calibrated to ensure that half the students score above the norm and

half below.

Rather than assessing students fairly on skills and knowledge they might reasonably be expected to possess, the tests are constructed to create, as U.S. author Herbert Kohl put it, ``a hierarchy of success or failure."

The kind of intelligence required to do well in standardized tests is a very narrow measure of a person's capabilities. Harvard University psychologist Howard Gardner has suggested that everyone possesses a number of intelligences, which contribute in varying degrees to each person's potential. In his book Frames Of Mind: The Theory Of Multiple Intelligences, Gardner differentiates among seven different kinds of intelligence: logical-mathematical, linguistic, musical, spatial, bodily/kinesthetic, interpersonal and intrapersonal.

Gardner contends that no one kind of intelligence is better than another. Each has its particular sphere of expertise. For example, writers are likely to be strong in linguistic intelligence, athletes in bodily/kinesthetic intelligence, visual artists and chess players in spatial intelligence. The traditional straight-A student demonstrates a high degree of logical-mathematical intelligence, this being the type of intelligence measured predominantly by standardized tests.

By focusing on one type of intelligence, such tests ignore other forms of intelligence that can promote success later in life. As a result, they often fail to predict how well a child will do at the post-secondary school level or in the

workplace.

Just as disturbing is the fact that standardized testing results in a narrowing of the curriculum.

That is because, where these tests are administered, school districts begin to alter their curriculum in order to ensure that their students will achieve high scores on the tests. Students read less widely, have less time for hands-on learning activities and spend more of their classroom time memorizing facts than exploring and learning from more open-ended kinds of experiences. They may learn to become good test takers, but it's questionable what else they learn.

Most tests do not teach students to analyze and solve problems and then to apply their skills and knowledge in other contexts. Students who have been coached to do well on skill-testing are unable to apply the same skill when the question is phrased differently from the original one.

Indeed, without direct teacher involvement and evaluation, thinking skills are difficult both to teach and to measure in a meaningful way.

But, as critics point out, direct teacher involvement is what is often lacking in computer-based education.

It is argued that computers free teachers to be more involved with their students on an individual basis, But direct teacher involvement can be better achieved by reducing class sizes.

Perhaps if more school districts cut

class sizes there would be less reason to spend money on technology and more reason to focus on the relationship between students and their teachers.

WHEN WE began work on this book, we knew that there was a tremendous amount of media coverage extolling the benefits of computer use in schools. We expected that the research studies we consulted would support this view. This proved not to be the case.

The more we examined research on various aspects of educational computer use, the clearer it became that there is a huge gap between the public's perception and the reality of what is happening in our schools. Even in schools that were considered to be exemplary users of computer technology, there were problems, often serious ones, that have been all but ignored by the media.

Again and again, the teachers and parents we met told us they had prepared our children ``for the future." Often we detected, underlying this insistence, the insecurity felt by many adults who have found it hard to cope with the rapid changes in computer technology in the workplace. What they were really talking about was not our children's education, but rather their future employment.

Teachers and parents seem to us to have been intimidated into believing they are neglectful if they do not provide children with access to computer technology, regardless of the way it is used.

What is missing here is any sense of the way computer use can contribute to educational goals.

The fact that computer technology plays an ever-larger role in many aspects of our daily lives does not mean that having children use computers at the earliest possible age is in their best interests. Other forms of learning should take precedence during the early years. As for the technical skills without which, we are constantly told, our children's future will be at risk, most people can acquire an adequate level of computer competence in a matter of months. Access to computers in high school would give students more than enough experience of the most up-to-date computer applications.

We believe the overwhelming majority of elementary schools have not benefited from using computer technology. Technology has simply added to the workload of overburdened teachers and created funding problems.

ELEMENTARY SCHOOLS have more important things to do than act as a training ground for employment. Young children need to develop intellectual curiosity, learn social skills and explore the sensuous richness of daily life. At this stage, children begin a process whereby they learn to discern, to critically appraise, to make connections and to approach life energetically, spurred by curiosity and armed with skepticism.

In pursuit of these goals, nothing is more important than the relationship

between the teacher and the student. Who among us has not had at least one teacher to thank for igniting an enthusiasm for science, music or literature? Curiosity is contagious. And teachers are much better at arousing the curiosity of children than computers. Good teachers convey their own interests and excitement in learning. They are not just concerned with what their students learn but with why they should know about certain things and how this knowledge can make a difference to them.

By encouraging questions and debate, teachers create a lively interplay of ideas and opinions. A computer program doesn't care what students think (having no thoughts of its own) and offers only a standardized, predetermined response. Children cannot challenge what it tells them. They cannot appeal to a computer's experience or understanding to discover why something is right or wrong or simply ambiguous. Only the presence of a sympathetic adult will stimulate them to ask the questions that play a crucial role in learning.

Sheer quantity of information, which is what computers can provide, is irrelevant. Grasping a few fundamental ideas is more important for a young child than having access to a vast mountain of raw data. Without a teacher to guide them, children will find it hard to impose any kind of order or coherence on what they learn.

An emphasis on learning with computer software threatens to undermine the student-teacher relationship. Teachers, we found, are

often viewed as mere adjuncts to computer technology, responsible for training children in its use.

Computer use, we discovered, displaces parts of the curriculum that are most enriching for young children. Arts programs, for example, have often been curtailed and sometimes eliminated in order to free funds and curriculum time for computers.

There is, however, no reason to suppose that replacing the arts with computer technology will improve our schools. In fact, there is a good deal of evidence to the contrary.

In contrast, we found that schools with an arts-based curriculum were remarkable for the high quality of student work. When arts are integrated into the curriculum, children are given ample opportunity to develop not only their imaginative and creative capacities but also their social skills. The arts feed the senses, heightening awareness of one another and the world we live in.

Mastering any art form requires patience and perseverance and encourages children to become confident and self-disciplined. Surely these must be among the most important educational goals we have for our children.

The fact that the arts are in danger of not being given their rightful place in our children's education is a reflection of a particular view of what education is for.

In his seminal book Technology And Empire, George Grant said: ``The curriculum is itself chiefly determined

by what the dominant classes of the society consider important to be known." The most influential of the dominant classes these days is the business elite, and so the corporate agenda looms large. Corporate leaders are adept at paying lip service to the need for creativity and higher thinking skills, but they often have strictly functional requirements in mind when considering educational objectives at the school level.

Many parents today have bought into this way of thinking. In Calgary, for instance, there is a proposal to create The Charter School of Commerce, where children would carry briefcases, wear shirts and ties, learn about mortgage tables and stock market movements and acquire much of their learning through headsets and computers. The single-minded objective of this school is to create high-tech entrepreneurs capable of entering the global economy while by-passing college or university.

Yet these students, whose creative lives will have been neglected, may not become the successful entrepreneurs their parents and teachers are hoping to create. What makes a successful entrepreneur are qualities like leadership, self-discipline, perseverance, an ability to deal with other people, drive and energy, and belief in a vision - none of which can be learned by using a computer.

When visiting schools with a heavy reliance on computer technology, we could not help noticing that computers tended to dominate the classroom. Because the computer

has come to be seen as the primary scientific and technological tool, children have access to computers, but no acquaintance with microscopes or magnifying glasses, chemistry sets, measuring scales, dissection kits, ``bug jars'' and other kinds of scientific instruments.

All of these earlier and simpler technologies have an advantage over the computer in that they involve direct, hands-on contact with the physical world. The same could be said of technologies associated with the arts such as musical instruments, crayons, paints, pastels, paper, costumes, clay, textiles.

All of these technologies are far more ``interactive'' than any single software program.

IT IS essential that children become emotionally engaged with, as opposed to emotionally detached from, the material they study. Our faith in one kind of technology has led us to believe, for example, that technical solutions can be imposed on natural ecosystems to suit our needs, whether to increase crop yields, replace old-growth forest with cash-crop plantations or produce hydro-electric power by building dams.

This faith has been bolstered by the fact that the benefits of our technological interventions often arise fairly quickly; the drawbacks emerge over a much longer time.

We have many examples of how scientific detachment and the application of technology without ecological awareness can go wrong.

But it is not just the complexity of the wilderness or the rural environment that children need to understand and experience first-hand.

The same is true of the cities in which the majority of children now live.

Computer simulations like Sim City or My World purport to allow children to manage a city, but in reality such programs offer a simplistic understanding of urban planning. Far too many decisions have been made about our cities based on theories that have not taken into account their complexity. Many of our cities have been blighted by urban developments intended to benefit those who live or work in them but which ended up having the opposite effect, diminishing people's sense of personal connection to the place in which they lived.

Jane Jacobs, one of the most influential critics of misguided urban development, has long insisted that her ideas have come from actually walking around the neighbourhoods in which she lives. Her observations, coupled with discussions with others in her community, have given rise to ideas that give a more complex and accurate understanding of the dynamics of city life.

The dynamics of human societies mirror those of natural environments in that they consist largely of many local events involving many different and often competing elements.

For young children, how these elements interact is best learned through their experiences of living in their local community. It is through

such experiences that children develop an understanding of what it means to be part of a community and a sense of the responsibilities they must fulfil if they are to contribute to the community's well-being.

As with the natural world, a true understanding of our human environment begins with direct personal experience of local conditions. Such conditions are highly complex and often require us to make difficult compromises. But to ignore them is not only to alienate ourselves from our immediate surroundings but also to deny much of our identity.

Children need to live in real time in real space with real people. Just as an infant requires a parent in order to feel safe and secure, children require a real social context in which to learn. Children can have electronic relationships with peers across several time zones, yet still be unable to create friendships with their classmates and so will have a limited and rather sterile understanding of human relationships. Today's children need more interaction with parents and teachers.

It is entirely possible that the most detrimental effects of computer technology will result from the way in which it pushes aside the experience of children and their teachers, encouraging exploration of an electronic world in which there is a vast proliferation of material but none of it is generated by the children, their teachers or their parents.

Imposing computers on young children is yet another technological innovation we might live to regret.

We don't really know what the long-term effects of regular computer use on children's development will be.

So far, the experiment has not been successful. If there are benefits to be gained from the use of computers in our schools, they have not been realized. And it is not likely that they will be while the integration of computer technology into schools proceeds at its current frantic pace.

Rather than putting its faith in computer technology, an egalitarian school system would ensure that all children were in small classes, had access to well-stocked libraries, had a curriculum rich in music, visual art and drama, and were offered good quality physical education as well as hands-on science activities.

There are encouraging signs that teachers and parents are beginning to question the use of computers in schools.

It is unethical to push students into a high-tech future and fail to give them the critical skills to understand the limitations that every technology possesses.

The struggle to use technology wisely and well is one of the most important challenges we and our children face, and schools are a crucial arena in which this challenge must be confronted.

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