Beyond Excitement: An Exploration of Computing in Education

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I will use ten learning axioms that I hold to personally and tenaciously, in order to explore the role of computers in education. Throughout, the notion of design in its fullest sense will inform what I say. If I had to name two attributes crucial to our survival and development into the 21st century, I would nominate struggling and designing. I do not mean struggling to convey negativity and pathos. On the contrary, I see struggling, the capacity to persevere and hang on there, the capacity to resist giving in, the desire to make it, as a key to all learning. Our school dropouts tend to be those who have given up the struggle. The hardest students to teach are those who have already decided that they will not be able to succeed. So, I would put struggling at the core of my curriculum; struggling constructively in English, Mathematics, History, Art and so on.

Similarly, I see designing as an attribute to be required and nurtured across the curriculum. By design, I mean a process which begins with the abstraction of a problem, challenge or goal, from the flux of experience, the imagining of a product or solution, the construing of possible modus operandi; the making, conceiving of a product, tool or idea and the testing of the outcome. Design, in this sense, is absolutely central to being human. In order to live and to direct our lives, we need to be able to plan, design and reflect on how well we succeed in pushing our imaginings into action. Design is not confined to art and technology in the curriculum.

Thus, if I were invited into your schools or institutions to evaluate your use of computers in the curriculum, I would want to ask, above all, whether the students are, in my terms, designers and struggling.

In addition to these two requirements, I would want to know how you, a teacher, viewed knowledge and science. To put it obscurely, I would like to find out whether you are modernist or post-modernist in orientation. I would want to see if you view science in the classical, rational, Enlightenment way, or whether (post quantum physics) you have come to question the limits of linearity and the myth of objectivity.

A friend of mine, Bill Green, and a colleague, Chris Bigum, have recently written, in draft form, a very interesting paper called Quantum Curriculum and Chaotic Classrooms, in which they foreshadow new kinds of classrooms, new kinds of student teacher relationships, and new attitudes towards knowledge in the light of post-modernist understandings of human endeavour:

... the rise into prominence of non-linear sciences, non-computable forms of mathematics, chaos theory and notion of structural indeterminancy, relative unpredictability and irreducible complexity. (Green & Bigum, 1989, p. 7)

Green and Bigum even cite me citing Donal Schon, citing Russell Ackoff:

[Teachers] are not confronted with problems that are independent of each other, but with dynamic situations that consist of complex systems of changing problems that interact with each other. I call such situations messes. Problems are abstractions, extracted from messes by analysts... [Teachers] do not solve problems, they manage messes. (Green & Bigum, op cit, p. 16)

All this amounts to an argument that teachers who still hold to a linear, rational view of problem-solving and knowledge generation, are likely to become quickly archaic and quaint in the post-modern world.

In this regard, Green & Bigum question the current state of computers in education:

Indeed, there is a sense in which the technological revolution associated with computing represents the apotheosis of science as the dream of Reason, the ultimate expression of the classical scientific world view. (Green & Bigum, op cit, p. 3)

The critique that follows is, I think, justified on the evidence I have seen.
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in South Australia with regard to computers in education. Green & Bigum point to the predominance of what they call procedural thinking in the field, questions about how to use the technology, as opposed to considerations of “the conceptual, ideological, cultural side of technology” (Bowers, 1988). They suggest that our teaching force is dominated by a comprehensive concern with technical aspects of the new information technology, in an exemplary instance of what Bowers calls ‘the technological mindset’ related to which is what Papert has termed ‘technocentrism’ (Papert, 1985).

Green & Bigum characterises this kind of thinking as:

... extraordinary, narrow and selective, structured by a narrow epistemological orthodoxy, a reductionist epistemology which equates thinking with data/information; data driven enquiry which fetishizes information and compulsively accumulates it in a spirit of pathological excess. (Green & Bigum, op cit, incorporating Bowers, p. 4).

Should I find that your view of knowledge and your view of computing is technocentric and excessively pathological about information (as opposed to understanding), then I would presume that you are not going to be much attracted to what now follows, all of which is premised on the belief that learning and curriculum should drive technology, not vice versa, and that there are no final solutions (knowledge is perpetually in a state of becoming).

**AXIOM 1**

**The human being learns experimentally by making constructions based on previous constructions of reality.**

In particular, the brain is not a linear machine. It is poly-attentive, able to blend cognition and affect; capable of holding multiple perspectives. Computers have been made by human beings to undertake some of the work that brains do. They are both energy savers and sources of energy which allow human beings to amplify their unassisted brain power.

Now computer programs have been devised to train and exercise willing human learners where the investigative, experimental intent of the learners is fairly low. On a slightly more sophisticated than animal training level, such programs can relieve teachers of the grind of inculcating certain facts, processes or techniques.

One should not decry the role of the computer as surrogate drill-sergeant, but one should be clear that this is low-level brain food. Given the intention of the learner to learn, constructions will be made, but the human’s experiment will be pretty safe, circumscribed and mundane. Many computer games create spurious excitement but I doubt whether most disturb the deeper reaches of the mind.

In a paper on “The History of Technology and education”, Alfred Bork (mimeograph in draft, August 1989) argues that many computer literacy courses in schools often amount to playing games with computers:

... the issues of student excitement are often raised, in using game-like programs. One could equally argue that pinball machines, free candy and open sex are valuable within classrooms, because they excite the students.

Axiom 1 would take us beyond spurious excitement to deeper levels of cognition and affect. In particular, it would require of any regime in which a computer is used as an adjunct to learning, the capacity for the learner to interrogate the terrain - not necessarily via the computer but in the wider context of the classroom in which learning is taking place.

**AXIOM 2**

**Human beings need to play with ideas and from the earliest times they have the capacity to reflect on the consequences of their actions.**

There is much to be said for allowing young children to play with computers. Indeed, I suggest that more learning about computers is probably occurring out of schools than in them, because at home there is likely to be less intervention into the computer use of the young than in schools.

Given a few rudimentary pointers, the very young tend to astound more hidebound adults with their capacity to find out what computers can do. I know a few teachers, confident in their own limitations and vulnerabilities, who are quite proud to admit that largely self-taught students are the key to classroom teachers and, very much as Margaret Mead depicted the young in New
In assessing how well computers are being used in schools, I'd like to get inside the heads of the users to find out just what they are intending.

Guinea returning to the tribes to induct elders into the use of transistor radios, they are establishing a post-figurative culture in the classroom by teaching their teachers.

In this regard, I suspect too many of our teachers may be too frightened to let go and trust the playful learning brilliance of the young.

**WARNING**  
*Do not censor playfulness as children grow older. Play is at the heart of learning.*

**AXIOM 3**  
Intentionally, a personal desire to achieve something, is the springboard of deliberate learning. Intending precedes reaching and grasping.

This axiom leads one to look at the motivation industry in schools, especially with respect to computers.

Are computers available as tools in the context of the full curriculum to be taken up and used by learners in the quest of solutions to their design problems or are they used by teachers as excitement machines, reserved for those who have successfully completed the mainstream drudgery? I suspect that they are also used a bit as films were and are used at times, as something to watch in last lesson Friday as a pleasant diversion or as a kind of educational condiment to add flavour to a tough assignment.

In assessing how well computers are being used in schools, I'd like to get inside the heads of the users to find out just what they are intending. Is there a *bona fide* intent to find answers or to use the computer to assist in achieving a desired end, or is computer time a time of intentional relaxation and escape?

On the question of intending, why is it that girls are for less likely to intend to use computers than boys? (Millan, 1989) Is it that there is something about male fantasy that is fed by computer work: the computer as a weapon in a war on the world? On the other hand, is there something about the content and orientation of computer programs that turns girls off: gross competition and vicarious violence? It should not be that computers are toys for boys, but the reality of computer use in schools, particularly in extra-curricular use, must give us pause.

**WARNING**  
*Brain power is shut down when someone else takes the responsibility for your learning. Instruction often precludes construction.*

**AXIOM 4**  
A major litmus test for learning in schools is the number of questions asked by learners.

Bork writes about computer simulation programs which he suspects are more interesting to the developers than to the students. He suggests that many students, unless strongly assisted by teachers to make sense of the simulation, simply do not know why they are using the simulation or what it is that they are supposed to be learning. He goes on:

I call a simulation that completely ignores what the user is doing, a naked simulation because it does not have the 'clothes' that it needs to be a full pedagogical unit. An effective simulation needs to watch carefully what the student knows and does not know, offering help and assistance. But few of these programs do. Naked simulations are seldom useful. (Bork, 1989, p.14)

If students do not find programs problematic or relevant, they will tend to go through the motions much as they do when bored or disengaged in normal classroom situations. If a program is engaging and problematic, they must then have the chance to ask questions, either interactively with the program or with a teacher or co-worker.

Student question asking is a crucial indicator of control. The aggressive brain of Axiom 1 needs to control the construction of knowledge. A key strategy in this, is the commissioning of information through question asking.

**WARNING**  
*To deny students the means and opportunity for production is to deny them power.*

**AXIOM 5**  
Students will tend to perform as they are construed. As you demand or expect, so shall ye be rewarded.

Not only do students tend to become what they are construed as by the teacher; they also tend to learn what they are surrounded by and engage in. If the classroom is a
The most healthy thing that teachers can do is demand and expect all students to learn to use computers to assist their learning...

...[boys] generally played games and believed this gave them both speed and insight. 'When you play all those shoot 'em up games your reactions speed up and you get to know how the programs work.' ... Boys had informal, out of school networks through which they exchanged information about games and swapped and shared games. (p. 30)

The research shows boys clubbing together and girls excluding themselves or being excluded.

Boys want to play games; they have a more confident approach. They don't want to do the set tasks; they want to experiment. (p. 30)

Boys spend more time on games; girls are more interested in typing. Girls are more interested in careers as teachers and secretaries. Boys start off with games and become devoted to the computer.

These sexist tendencies tend to be exacerbated by the strong connection in many schools between mathematics and computing, especially since male teachers are predominant in mathematics.

Schools which stereotype computing in this way are doing great damage, in my view.

It is also important for schools not to raise false expectations about vocational value of computing. We should promote computers for their capacity to enhance thinking, as an intellectual tool, rather than as a false (or likely to be false) passport to a technological paradise. Sue Willis provides some sobering caveats:

Only 7% of the workforce will involve high-tech positions for programmers, technicians, computer operators and engineers. Most job openings in the next decade will be for janitors, nurses aides, sales clerks, kitchen helpers and truck drivers ...Workers who will need to know something about computers, such as travel agents, airline reservations, or telephone operators, will be able to learn what they need to know about these particular machines in a few weeks or less. (Willis)

The most healthy thing that teachers can do is demand and expect all students to learn to use computers to assist their learning and to construe computers as across the curriculum tools for intellectual quests rather than as instrumental goals in a technological worker's paradise.

WARNING
Unwittingly, we often carry institutional and societal contamination into the classroom and thereby discriminate against certain groups. Be alert to the unspoken message inherent in the school and in your classroom regime.

AXIOM 6
Learning will occur best in classrooms where there are rich and explicit demonstrations and opportunities to learn, so long as students are able to 'read' the school culture and to participate in shaping it.

Learning about and through computers will clearly occur best where there are frequent opportunities for purposeful hands on and opportunities to observe competent users at close quarters. The richer and more explicit the demonstrations, whether from teacher or from peers, the more likely, under an apprenticeship type regime, learners are to catch on and to develop confidence.

It is important, I believe, for computers to be seen as ordinary, an organic, matter-of-fact, part of daily life in the classroom.

I don't want to be doctrinaire about the computer room, where twenty
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computers await special computer classes, but I would suggest that such deployment of computers tends to emphasise their extraordinariness and to symbolise computing as a specialism as opposed to a pervasive, ubiquitous, learning tool within the reach of all.

Axiom 6 reminds us that some children, and particularly some boys, will come to school already confident and gung-ho about computers and about the culture of schools in general.

Others less privileged or with different cultural backgrounds, may initially find schools and computers within the schools alien and daunting.

I contend that all teachers have an obligation explicitly to demystify schools and technology for all students, especially those who are likely to have come from minority or oppressed groups of the community.

This is where we must go far beyond procedural or technocentric approaches to technology, to put squarely on the agenda questions of culture and ideology. What are the pluses and minuses of new technologies? In whose interest do they tend to operate? How can they be appropriated to make the world a better place?

discriminate against certain groups of students.

AXIOM 7
As is the evaluation, so is the curriculum.

Teachers will, and should, teach to the tests that society values, even if they know that these tests often distort and reduce the curriculum. If no assignments ever require use of computer, students will soon get the message that computing is an unimportant extra. Until society says it values the capacity of students to use computers to assist their designing and learning, and then insists that schools test these things (starting at Year 12 to indicate the true seriousness of the valuing), then assignments are likely to continue to be fairly old hat and traditional.

Start to require demonstrated capacity to use computers across the curriculum as a prerequisite for university entrance, and watch the burgeoning use of computers to assist learning throughput schooling.

WARNING
Don't deride teachers who teach to the tests. If teachers don't have power to change the tests, they have an obligation to help their students succeed at what is valued.

AXIOM 8
Learning power is increased each time we transform knowledge from one medium to another.

Jerome Bruner has said that each time we explore a territory through a different medium, we transform that territory and intensify our knowledge of it, at the same time as we extend our repertoire of skilled performance.

Sadly, schools tend to be very technocentric. Reading and writing tend to dominate as vehicles of learning to the exclusion of enactment, painting, sculpting, filming and computing (especially using graphics).

Bruner's dictum would spur us to enrich the learning media used in schools on the grounds that this would intensify knowledge. He would not see computers, then, replacing other means, but he would argue their strong inclusion as a means of seeing territory from new perspectives.

The capacity to design a product and through graphics, then to examine it three-dimensionally through the use of computer, surely enhances the learning and the quality outcome.

The capacity to manipulate words and sentences through a word-processor can throw new light on language form and function.

Recently I've seen some extraordinary good work being done at Maryattville Primary School where a class is taking multi-media approaches to learning, making animated film, with accompanying commentary and music, through a combination of computer graphics and video applications.

By comparison, strictly language bound classes seem plodding and in danger of becoming peripheral in the new millenium.
...teachers will need to use computers much more dynamically...

**WARNING**
Fright habit in setting tests. Most of our present testing practices constitute a brain hazard.

**AXIOM 9**
In learning to use computers, learners need to be shown how each kind of use works in context and then be able to play with it and use it.

I am arguing along with Bork, whose paper I have cited, that computer use should not be a kind of cosmetic adjunct to education, but that it should truly and integrally serve the curriculum.

In designing courses and curricula we need to build in computers right from the start, in terms of curriculum content, learning strategies, learning products and assignments.

Ideally we should not just pluck tools from business applications. We should "naturalise" them to education, tailoring them to the specific goals of schooling. Too often, Bork says, we graft business applications onto an otherwise undisturbed traditional curriculum with fairly predictable consequences. In these cases:

...the focus is not on learning, and on helping students to learn, but on the technology. A friend likes to say that any piece of learning without a curriculum context is like a 'one night stand'. The analogy seems to me a good one; no full rich relationship is developed. (p. 19)

I want to support Bork's view that we will continue to have this kind of surface technological titillation until we redesign from scratch all of our courses, to integrate within them learning applications of technologies.

**WARNING**
Students who walk unregarding through the rich jungle of school languages and media are sure to be done in.

**AXIOM 10**
Demonstration at the point of desire-to-know is at the heart of effective teaching.

By this axiom, teachers (acting from an understanding of Axiom 1) will not instruct before students have confronted the fact that they need to know.

Premature instructions from the teacher usually precludes students' turning on their brains. It's no good instructing if the student's construction plant is closed down.

This all points to the need, wherever computers are being used in education, not to patronise learners by helping before help is commissioned.

The good teacher will throw out the challenge, give minimal necessary guidance and then wait for questions to be asked.

When he/she eventually teaches at the point of desire to know, the demonstration will be both powerful and effective.

**WARNING**
The helping hand can be a mind opiate.

**Conclusion**
In this exploration, I have begun to broach the computer territory beyond excitement and technocentrism.

I have suggested that in all subjects, teachers will need to use computers much more dynamically, to open up possibilities, to contemplate designs and to speculate about how to construe pathways in a turbulent and complex world where knowledge is always evolving but never finally pinned down.

I'm pleased to say that designing and planning are to be essential skills in our charter for the 21st century and I see computers playing a key role in the development of these skills.

I look to your association, to promote computing across the curriculum and to play a significant role in the initiation of more and more teachers into the wonderful, brave new world of amplified brain power through technology.

**References**