Computing and the Internet in Schools:

An International Perspective on Developments and Directions

Gary Stager

This paper develops themes explored by Gary Stager
in two IARTV Seminars which were presented in Melbourne
in April and September 1996

Editor's Note:

Gary Stager's seminar presentation was delivered during a 'flying visit' to Australia. This paper has therefore been developed and edited from a tape of the session. An attempt has been made to balance the format of a paper with a reflection of Gary's vibrant presentation style, retaining elements of his conversational approach and occasionally colourful and provocative expression, used to stimulate what he sees as an essential and serious debate on rethinking the relationship between education and technology.

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INTRODUCTION

Alan Kay defined Technology as *'Anything that wasn't there when you were born'*. For today's children — our students — computers are not 'hard', or 'worthy of study', although that is the message that we give about them in school. In fact we invent entire industries and curricula called things like 'Information Technology' — just one of those ideas that have been exported to Australia from America, along with the old chestnut 'Computer Literacy'.

These were reactions to new and powerful technology being put into schools, to be greeted by educators who were not content simply to have 'computer users' in their classes, but who then went about finding a way of creating a bell curve from 'good' computer users through to 'bad' computer users.

If you can remember when television came into your home, you may still look at it in wonderment. To children such technology is just a part of their environment. In many cases what we do in schools with computers is therefore at best a history lesson and at worst a parody. I have seen schools where every student has a 486 machine, but for one hour a week they go to the Apple II Lab for Computer Studies because that's what it says to do on the timetable.

I have worked in computer labs. The simple fact of the matter is that what can be done in a computer lab is precisely what can be done in a computer lab. A lot of what students can do there is based on the time constraints of the timetable, the expertise of the teacher, and the ability and willingness of the teacher to let the students go and learn things on their own. People who work to computer lab parameters are continually having to come up with activities — often very clever ones — that last for exactly thirty minutes.

It seems to me that after fifteen years of 'Computer Literacy' nobody seems to be really 'literate', and very few can 'compute'. Since I am among friends, dare I whisper the awful secret that we have not really achieved very much?

On a more positive note, the types of activities which we have been developing with schools on my most recent visits to Australia are quite alien to the type of activity described above. The experiences we are trying to provide for students are ones where the basic premise is that one works through something until it is done, and to a level of pride.

We work from the idea that students should be wanting to come back to something the following day — that there is a need for them to do so; that if there is a bug in what they were doing they will want desperately to come back and solve whatever is the problem.

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RE-THINKING COMPUTERS IN SCHOOLS

I believe there are two real truths when we are thinking about the issue of technology in schools:

1 **Child friendly classrooms are technology friendly classrooms.**

   In schools where there is a tradition of child centred education — where students are actively engaged, where teachers respect the students' work, and where there is genuine communication and collaboration — technology seems just to 'slide in' and succeed.

2 **We must allow for serendipity.**

   The technology is new. Our use of it is new. Students learning with it is new. There are all kinds of wonderful connections to be made, if we allow for some serendipity — if we do not, for example, buy packages that were designed by people misguided enough to suggest that they knew precisely how children would use them.

'Re-thinking computers in schools' has become all the rage in schools in the last few years. Somehow it's as if computers have become passé already — a school based fad — as if the rest of society has not been transformed by them.

"*Maybe*", they seem to think, "*we ought to be doing Deep Sea Yugoslavian Folk Dancing, rather than 'doing Laptops'*".

It is intellectually unsound, however, to suggest that society can be changed radically by technology without a similar impact on schools.

What are the 'truths' about computing?

1 Some things can be done best with a computer.

2 Some things can be done only with a computer.

3 Some things can be done better without a computer.

An example I sometimes use to illustrate how we need to re-think when it is appropriate/best to use computers, and how careful we have to be about carrying that through into the curriculum, comes from Year 7 or Year 8 maths:

- The working of an equation is being taught and then graphed.

- The axis is drawn carefully on graph paper, and even more carefully the appropriate points are found and marked.

- The dots are then connected.

This activity might take an entire class period. At the end of that class period, however, the chances are that the student **knows** little more — or effectively nothing more — than before the lesson.

What of technology? There are now any number of companies that will sell you really good software for achieving the same thing — but faster, more accurately, easily modifiable to allow for changes of data, and in colour. At the end of the day, I would argue, however, that in all probability the student still 'knows' nothing.

A lot of content and methodology, as well as tools and process, are called into question when people start to think about the appropriate use of technology in the school. The computer is both a window on the future and a magnifying glass on the past. Let us explore this further.

The convergence of technology and education — the case of mathematics

Research by the US Department of Education surveyed Year 10 students and asked them about their maths classes. The researchers asked four questions:

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1 *How often do you copy the teacher's notes from the blackboard?*

18% said Never

34% said Sometimes

48% said Often.

2 How often do you participate in student-led discussions?

41% said Never

40% said Sometimes

19% said Often

3 How often do you use books other than textbooks?

70% said Never

18% said Sometimes

11% said Often

4 How often do you use computers in maths classes?

84% said Never

13 % said Sometimes

3% said Often.

Consider the results of these survey questions. I had actually thought that computers were mathematical (computational) instruments!

Let me put this in context. Recently I spoke in the USA at the National Council of Teachers of Mathematics Conference — a conference which attracts some 20,000 participants. The number of sessions on the program of this regular conference that mention 'technology' of any sort in their abstracts has steadily declined over the last decade. The number was down again this year, for the tenth year in a row, and hovers around 5%. Take out mention of calculators and the figure would be lower still.

Another contextual comment: I carry a little mathematics dictionary with me. Most people don't know they even exist. When I show the dictionary to them, they tend to react by asking why we would spend all these years trying to memorise material which the book can describe so concisely — usually in a couple of sentences.

Let me be provocative in theorising about the lack of computer use in mathematics classes: I think maths education in particular traditionally has been built on the notion that only a handful of children can be let in on the secret. They are the ones who do well. Now, however, when we have technology which allows a lot more children to be let in on the secret, the maths community shows little sign of grasping the opportunity. If as many students dropped out of physical education in the USA between Years 11 and 12 as do from mathematics, I am sure tribunals would be held to address the national crisis.

This is interesting, because the National Council of Teachers of Mathematics' statement on Standards in the USA contains a wonderful sentence in it, stating that 50% of mathematics has been invented since World War Two. I challenge you to find much if any of that reflected in your school syllabus, or in your textbooks, yet it is precisely these sorts of mathematics — which are visual and that you can play around with, like number theory, fractal geometry, chaos and so on — that a lot more children might fall in love with if they knew them as 'mathematics' and became involved in solving problems. They are not being exposed to them, despite the fact that the computer makes most of this possible.

Re-thinking our beliefs about education, and about the place of technology within it

We need to be clear about what we believe about education, and what we believe about technology in education in particular. In that context, basically I would argue that there are three ways of looking at computers in education.

1 Computer based teaching (CBT)

I will really only mention this approach in passing. In this model the computer is no more than an instructional tool. I characterise it as "sitting the student at the computer and setting the controls on 'Stun'", based on the notion that you can 'shoot down' phonics, or 'bomb' dypthongs, or 'squash' long division problems.

All I can say is that, in my opinion, any teacher who thinks teachers can be replaced by computers probably should be. In addition, if we really believe

that students learn that way, and moreover that they can learn everything they have to learn in 45 minutes a week, well, we could be saving an awful lot of money on schooling, couldn't we? The children could be invited to come in for an hour once a week, and I am sure that the community could provide a lot more interesting activities for the children at a much lower cost …if we actually believed that children learn that way.

2 Doing Work

Having made my point about the dangers of seeing computers as **just** an instructional tool, or as some kind of instructional panacea, let me stress that there is nothing wrong at all with using tool-software to get a job done. Word processing, for example, was the revolution of the eighties. It has dramatically altered the writing of almost every human being who has ever touched one. It makes the process—the taxonomy of pre-writing/ writing/re-writing — more fluid. Children write more; they write better.

Nobody I have met has ever said that word processing is a bad idea, or that they will give it up. However, it does not need a nine year scope and sequence, such as a lot of school and technology committees have cleverly crafted. I can teach a five year old to word process in about five minutes — "Type some letters, and use the back space key when you make a mistake". Everything beyond that is at some level of abstraction that we can learn along the way.

3 A Learning Environment

So, as far as I am concerned, the focus of using computers in the classroom is not on the tool. If you want to desk top publish, that's great. If you want to crunch some numbers use a spreadsheet. That is exactly what ought to be happening.

On the other hand, what interests me far more is seeing the computer as **an environment for learning — as an intellectual laboratory and a vehicle for self expression**. For that reason I have been doing a lot of work with software like Microworlds, where there is no threshold or ceiling; where children can invent their own knowledge and make connections between curriculum areas that never existed before. In this kind of environment they may solve problems of personal significance in ways that the adults in their proximity had no idea about prior to the activity taking place. When you think about these latter two ways of viewing computers, there is room for both. Clearly understand however, which is the more important. In my opinion, erring on the side of learning is the correct decision.

I also believe that if you are using technology as some sort of vehicle for educational reform — for school change; to make classrooms more sympathetic to the needs of children — the best way to get yourselves, your staff or your children thinking about the future and breaking the mould a little bit, is by having them involved with software on the learning side, with the sorts of open-ended environment that I mentioned before … more so than on the tools.

Software and task: the case of WPDBSS

'WPDBSS' is an acronym. It unpacks to be 'Wordprocessing/Database/Spreadsheet', which is usually said as a mantra, very quickly and blurred together into one syllable, throughout the educational community. Never once does it seem to have been called into question.

Schools who cannot agree on anything else agree that WPDBSS is something that every child needs to do. It's in the top three bullet points in each school's mission statement or guidelines for technology use. It has become a kneejerk, built on a business model — the notion that if the stock market uses the computer in this way for greater productivity/efficiency, then we should do that at Year(s) X in our schools.

Now, I am **not** saying that children **don't** need to do WPDBSS at all, but let us keep things in proportion. Let us know why we are using the computer in these particular ways for particular tasks, and why in particular circumstances with particular students.

Let us be clear about what we are trying to achieve; let us try to assess how important/significant that achievement and learning is likely to be.

Again, in the case of WPDBSS, I think that the tool-use is often somewhat questionable when serious criteria are applied.

What are the key points here?

- The children can use the tools, or not use them.

- We and they ought to understand the tools.

- We and they ought to make decisions based on the understanding of them.

- We and they ought to put them in proper perspective.

- If you are using a tool software (like Claris Works or Microsoft Works) or a learning environment software like Microworlds, it need not be one and then the other. There is no hierarchy of software. You should use what is appropriate to the task. If the piece of software is valid it ought to be in the children's 'bag of tricks'. Then — on the basis of knowing what they want to do; knowing what the software will do; and knowing how they wish to express themselves — the children should be able to decide which tool is appropriate for the particular need or task. In the age of Java applets, OLE and OpenDoc containers, we will find tool software, or specific pieces of it, used to support what is constructed with the learning software.

More importantly, perhaps, since I am addressing adults, is that such decisions, and any subsequent judgements about resultant outcomes, should not be based only on an adult aesthetic. I immediately become suspicious when an adult suggests that one piece of software is 'easier' or 'better' than another. By this I mean that when the children have produced their work using particular tools, it is not enough for the teacher to compare what any two displays look like on the screen and say 'That one looks better.' What is on the screen may not demonstrate the process through which a student has worked, or the value of the work to that student. People do not look at an example of Year 1 art and say *'Boy, that looks dreadful!'* First of all it's not a nice thing to do, but secondly people have an appreciation of what Year 1 students can do, and what is the process that went into the art that the student has created. Similar sensitivity and knowledge is necessary when making judgements about student work with computers.

I am not arguing that every teacher needs to be an expert in every piece of technology ever written, or every piece of hardware ever developed — that is obviously not possible — but it is necessary to have some healthy understanding and respect for what children are capable of doing through the use of technology. In building that understanding, we should be trying to move away from the Tool/Tutor/Tutee model of thinking about computers — that you use it to make something, or that it does something to you — and towards the Papert metaphor of 'The Computer as Material'. The Papert model recognises that the computer is malleable; one of the most flexible inventions in history. It can be lots of things, and can be used in many different ways to express and enhance yourself with a pallet of ideas.

If you think of the computer as materials — more like pipe cleaners or papier maché — it is unreasonable to think that a teacher who can build a curriculum around pipe cleaners couldn't do the same with video clips, or with other multi-media, or with the Internet, or with Microworlds — with children using the materials in personal ways.

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INSTRUCTIONISM AND CONSTRUCTIONISM

To take this line of thinking a stage further, consider the debate framed by Seymour Papert regarding **Ins**truction and **Cons**truction.

Instructionism is based around the idea that if you want to improve schools, or help a student learn, you just teach better. You lengthen the school day; you buy a new text book; you talk louder — you tinker around the edges. The approach is based around the tabula rasa model of children being empty vessels to which you will deliver content, and the notion that somehow I can do something to make you learn better.

Constructionism, by contrast, is based on the Piagetian idea that you go through life collecting bits and pieces of information that sit in your head waiting for some powerful context in which you can glue them together and make some meaning for yourself. Ideally the school will provide those types of glue experience, rather than just filling your head with more pieces of information. Papert suggests that the best way to ensure that this happens is to be actively engaged in making something, and in making meaning for yourself. Making something does not mean having to make a table or a volcano. It can be a conversation, singing a song, writing a poem or a computer program.

Constructionism is about making connections. Really powerful problem solving is not about solving YOUR problems; it is about solving MY problems. We often lose sight of that. When we really want to achieve deep learning, we want to make connections to personal interests, experience and knowledge — connections between ideas, disciplines, each other and the world.

In this context, it is clear to me, and to others, that we are undergoing a transition from the passive transmission/receipt of information, with many of the connections spelt out to us, to the process of personal construction of knowledge. This is happening whether we want it to or not. If schools do not come to grips with the changes that are taking place in society, and the demands that children are making, and that society is making of children and teachers, then we are in serious danger of becoming irrelevant and obsolete.

THE INTERNET

What about the power of the Internet in the context I have outlined above? The Internet is blowing away the artificial boundaries between subject areas. The way you look for information has nothing to do with what it looks like in the school timetable. It provides unlimited access to information.

You've heard all that. Don't forget however that this is not inherently a 'good' thing. Unlimited access to information can lead to the worst, most instructionist use of the technology ever seen in education.

The potential is there to see the Net as nothing more than the best way to pour information into children' heads, unwillingly. Boot up the computer; link into Internet; and someone in Texas — or London, or anywhere else for that matter — can create your curriculum for you.

You will start to see that happening. All the 'big players' in the technology marketplace are interested. Often they are using the 'right' altruistic language, about children constructing learning, but in reality it is difficult to see how they can make money out of what is essentially a **personal process**. On the other hand, **content** is relatively easy to package and market. Many people already own content in great quantities and are keen to resell it. No teacher needs to be told that content, or quantity of content, is not enough.

If there are potential problems with use of the Internet in an educational context, what are some of the potential strengths?

There are opportunities for communication, co-operation and collaboration — teachers talking to other teachers; teachers team teaching; teachers becoming involved in inter-disciplinary courses, working on collaborative projects of all types; working on science with 'real' scientists; collecting data all round the world; creating a newspaper within the school, in real time, daily, rather than waiting for weeks or months.

However, remember that co-operation begins at home. If you have classrooms in rows, where the children never talk to each other, then it is highly

unlikely that you are going to succeed with any collaborative projects in cyberspace. There are all kinds of new demands that are made of you when you are dealing remotely with, and collaborating with, other people. You need to come to grips with the principles and practice of co-operative education and collaborative problem solving in the classroom.

The Internet as a democratic force

Perhaps the most powerful and exciting aspect of the Internet is this effective democratisation of 'publishing'. This has been largely forgotten in the debate on educational computing and the Internet. What I mean by this is that an eight year old can contribute his mathematical discovery to a world of mathematicians, just because s/he has the access. In this respect every user is equal; the Internet is democratic.

Ford, IBM, General Motors or MacDonalds may have Web sites, but so do I. So do many of my readers. We can provide input to whatever extent we choose, as well as search for information provided by others. That is powerful for me, powerful for you, and powerful for the child who also has a Web site and can therefore contribute to this electronic world of knowledge.

One of the problems with traditional print text in the past has been that you either have breadth or depth. For example, you can have a book on every kind of spider, with very little information on each spider, or you can have a specialised book on just one type, say tarantulas. The Internet, by contrast, is boundless, so you can have both breadth and depth.

For example, recently I was asked to prepare timelines for the lives of famous American civil rights leaders. In reading a book on Martin Luther King I came across a mention of the birth of his first son. 'First' implied there were others, but in most cases, unless those 'others' did something momentous, such books would be unlikely to mention them. Sure enough, I had a really hard time finding any reference to them.

In that situation, an eight year old girl — who just went on a field trip to the King Museum in Atlanta, or who went to the library and found the book I didn't find, and who then wrote a three paragraph book report which she put up on the Internet — might well be of use to me. Her information would be of use to me just as the Pullitzer Prize-winning biographer's would be of use, or even the autobiography of the person himself. It would be up to me to assess the value of her information and take any necessary further steps to check its validity.

Major institutions like State, national and university libraries are busily digitising bulk information, but they cannot do it fast enough, to keep up with the sheer quantity of information. Recently, however, I have heard people at conferences suggest that when the institutions have done it, this will be where all the GOOD content will be held. All the rest, they argued, will be BAD content.

What is not being faced in this line of argument is the impossibility of the task. This is a job that is not going to be solved by large institutions alone; it is going to be solved by eight year olds or eighty year olds; by ordinary people as well as extraordinary; by people in this country or any other country. These are the people who will be contributing, while agents on the Net will stitch together the related pieces of information, and tell you where to find them. It is relatively easy to publish in this way.

These are extraordinary times. Without over-dramatising, we all have the opportunity to participate in history. All the hype is probably genuine, for the first time in a long while. There is a new Web site every four seconds. The size of the Web is doubling every 55 days. Those of you who are not on line should at least be thinking about it, just for the sake of witnessing history if nothing more.

Teachers communicating

At the simplest level, using the Internet in the classroom means that teachers get to make contact with the 'outside world' by using the phone. Well … not exactly … many schools still seem not to trust them with a hand set. A hundred and twenty years after Alexander Graham Bell spoke into a receiver and said 'Watson, come here, I need you!', there are school councils taking a wait-and-see attitude — perhaps they're waiting until all the bugs are ironed out!

What is, quite seriously, a major revolution in terms of teacher communication, is occurring in a context of radical and inexorable technological change. Attempts to control the expansion of electronic technologies will fail in schools as they are failing elsewhere in society.

Industries based on technologies of the past will disappear unless they adapt to new ways of operating. For example, the publishers and book shops, the record companies and CD retailers may be seen as the modern equivalent of the wagon and buggy companies in the early days of the automobile.

Consider how things have changed. You can go on-line and order anything you want from anywhere in the world and have it within a couple of days. In eighteen months, maybe five years, the music you currently buy on a CD will come through a line, direct into whatever the new machine may be.

The issue is about control. In schools, teachers who are on-line may be talking to others in Bulgaria, or Canada, or in other sectors within their own State, or to anybody else who has the appropriate equipment, about any topic they choose. The administration which currently may not allow them to call the local library to find out if a book is in, or to ring a parent to talk about a student, will be faced with a situation where they are collaborating with teachers, or policy makers, or researchers, all over the world.

This will change the command-and-control structure of how technology is used in the school and in the classroom. It will change the ways that schools operate beyond the classrooms, and it will change relationships between administrations and teachers within schools.

Undesirable uses of the Internet

Periodically, stories hit the headlines about undesirable uses of the Internet by children — for example accessing information about explosives or pornography. The media coverage tends to employ language that portrays the Internet as BAD, BAD, BAD.

As in other fields, 'news' which is sensationalised is often short on fact or commonsense. One American television 'Bad Internet!' story which I saw showed a reporter sitting next to a PC with the monitor facing the camera — with a word processing package on the screen. Priceless!

The problem is not that the Internet is 'bad'. The problem, as with any other information source — books from the library, for example — is how the information is used.

There are ways of dealing with problems that are associated with access to information. There are reasonable precautions you can take in the school setting. You can discuss etiquette and safety issues in the context of broader considerations — just as you advise students not to get in a car with a stranger, you can educate them about the importance of not giving out their phone numbers, and using anonymous user names. You can create Acceptable School Use policies, and advice for parents about home use, advising them of what their child might stumble upon in either school or home setting, as well as suggested guidelines for what they can do in terms of monitoring.

Let us keep this in proportion. It is my belief that with the level of access that most students have in school, they are very unlikely to get into trouble. There are two key points to make in this regard, as far as the school situation is concerned:

> *In schools, teachers who are on-line*
> *may be talking to others in Bulgaria,*
> *or Canada, or in other sectors*
> *within their own State, or to anybody else*
> *who has the appropriate equipment,*
> *about any topic they choose.*

1   In terms of practical realities, if students try to get into undesirable sites using the average slow speed modem, and granted the kind of monitoring that teachers do customarily in the classroom, you're going to have time to catch them!

2   The best way to make sure children are not **de**structive, is to keep them **pro**ductive. Have them actively engaged in something that is appropriate and check that they are remaining on task.

Attempts to impose censorship as such are unlikely to be workable, as is apparent from recent cases in the USA. In any event, educating students for good citizenship, use of common sense, and informed decision making is always a better alternative to imposed 'solutions'.

What I have considered so far, however, is only the question of undesirable 'bits' as they are defined by the media.

As far as I am concerned, the really undesirable 'bits' with the Internet are:

• ignorance

• not understanding the Net

• not understanding its potential

• not understanding that you can take reasonable precautions to check, for example, the sites being accessed by your students, and

• the notion that 'bits are bits' — that all information is equal in the digital sense.

I am often asked questions like:

• 'But how do we decide how to use it, and what to use?'
• 'Which information is more valid?'
• 'Who is a good author and who is a bad one?' and
• 'Who should we trust?'

I reply that although I can understand why people might ask those questions, that they are not the basis for avoiding the use of the Net. I think the real cost is doing nothing.

If you think that it's tough standing up in front of a room full of Year Fours and saying *'You'll need long division when you grow up; it makes you a little nauseous and sleepless at night, but it will be worthwhile in the long run'*, try telling them that the world is not connected, that as the teacher you are the only one who knows anything, and that there is no access to the Internet for them within the school.

In the USA at least, you can have virtually unlimited access to the Internet for around $20 per month. Lots of people do. Then students come to school and get 'two sentences on deserts, or the middle east', or 'three sentences on Australian history from 1960 to the present'. Children are not going to tolerate this. They have much higher expectations, which will multiply as they increase their use of technology in their personal contexts.

At the most fundamental level, when you look at the amount of things that children learn in an average school hour, ask yourself whether there are not more efficient, effective and cheaper ways for them to do that. If you want to do no more than buy surveillance, that's really cheap. You could use the same computers to make sure the children don't hurt themselves, and don't go anywhere between 9 and 3, but is that education? Is that recognising the enormous potential of the information and skills we can now help students to access through effective use of the new learning technologies?

Issues of access

Of course, there are issues to be faced in terms of equity and 'equal access'? Is equal access having a particular type of modem, or having particular types of line connected into the classroom? Is it something as simple as having a suitable computer available?

In California, a recent statistic I read (and I have no reason to believe that it is greatly different in Australia) is that there is one computer for every 70 students capable of surfing the World Wide Web. When you think about access, that is the basic issue.

A year or two ago, when I was doing talks around the USA I asked my audiences how many of them had access to the Internet. I was astonished — even granted that these were self-selected groups — that in a period of around 12 months I went from very few to approximately 75% of the teachers I asked. They did not do this through an Act of Parliament, they did it with their Visa card. Why? The Internet was about talking to people and about getting information. Teachers who months before had been complaining that they could not understand how to use a Mac, or who were constantly asking for more professional development on the use of computers, suddenly were working out Web site addresses and accessing Ozemail Tech Support — doing things that were technically relatively difficult—because there was now a meaningful context for them.

What has also happened in the last twelve months is that the schools and/or school authorities have started to get on board — every school has to be wired and the Internet is the 'hot thing'. What you find, however, is schools who have Web sites with nothing on them. They stake their real estate and say 'This is where we live — Under Construction'. Go to Web 66, an international list on the Web of schools that are on line, and you'll see that what I'm saying is true.

Why are most of the sites empty? Time is an issue, as is access. Teachers and students may or may not be allowed to have accounts. If they have accounts, they may 'surf' the Net, but not publish. In schools, the Net has gone from a tool for personal expression to yet another delivery vehicle. Hopefully this situation will change with time.

Software sales are reportedly down because schools are buying wire. Are they buying ideas? It is good that schools are putting in infrastructure, but now it is time to use it appropriately.

LESSONS FROM THE NET

In a speech on Education and Educational Computing that Bill Gates recently delivered nationally on US television from Georgetown University, he seemed to suggest that one great thing about the Internet in the future would be that teachers would be able to download lesson plans, for example to suit 'Year 4 Geography'.

It occurred to me when I heard this to ask when it was that I last heard a teacher ask to borrow a lesson plan. When was the last time you saw somebody write a lesson plan? You know, the ones you had to write when you were at university — eight pages long, with the procedures, the assessment and the objectives.

To my mind, the notion that we are going to use the greatest communication vehicle ever, to deliver lesson plans, is not a useful one. In a worst case scenario, if implemented, such an approach could be a way of controlling what teachers do and what children learn. Since the idea is being suggested by a representative of industry, rather than education, presumably there would also be issues to face of how such material, or its delivery, would be paid for.

We can go one step further. Why are we still talking about "Year Four"? Have we not agreed that maybe we ought to rethink the idea of organising children in classes based on when they were born? For that matter, what is "Geography"? Who is going to decide?

There are multitudes of problems with the approach being suggested, yet at least in the USA an infrastructure and set of industries are being built on just this notion.

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Have we not agreed that maybe we ought to rethink the idea of organising children in classes based on when they were born?

For that matter, what is "Geography"?

Who is going to decide?

LEARNING BY DISCOVERY

Let us move beyond the idea of using Internet to source lesson plans, and take another way of looking at education. Let us consider the capacity of students to learn through discovery.

Billy and the negative fraction

I have been working in a number of countries helping children to write Logo programs. In one case I was working with "Billy" to write a program to add fractions. We were creating a fraction calculator, since calculators do not do fractions very well. We wrote the procedure and asked whether he could write one for subtraction. All he really had to do was change the title of the procedure and change the plus to a minus.

Billy could do it, and wrote "SHOW SUBTRACT ONE THIRD TWO THIRDS" which means "take two thirds away from one third". The computer came back with the answer: "negative one third".

I said *"Boy, that's interesting, Billy"*, as he moved on quickly to the next problem, *"I seem to remember when I was in school that the teachers said you cannot have negative fractions."*

"What, are you kidding?" said Billy. *"You can't have negative fractions? The computer gave us one. It's on the screen!"*

This led us into a discussion about the difference between symbols and numbers — about why there would be conventions; why mathematicians would say fractions are different from decimals.

Billy was sure in his own mind about this: *" First of all"*, he said, *"the computer gave it to us, and secondly I can give you a real life example."*

At this point I had that sinking feeling that as a teacher I was now in big trouble! *"OK,"* I said, *"Let me hear it."*

"Well," said Billy *"I have a birthday cake divided into six slices. Eight people show up at my party. I am short two sixths of the cake. There, you have examples from the computer and from real life; therefore you can have negative fractions."*

I would argue that Billy's discovery is as important as anything by Descartes or Euclid — certainly in terms of his learning.

I spent the next couple of months asking maths educators both in Victoria and in the USA. Most of them said things like *"Sorry, I'm busy, leave me alone ... I'm marking things ... I'm trying to get the blue off my arm from erasing that last overhead"*. I went to maths dictionaries and they were vague at best. A few months later I was at a party with a real university mathematician, who didn't say *"That's a stupid question"*, but instead asked me for my email address, and the following day sent me a response. He had consulted his favourite encyclopaedia, where the entry was apparently written by an acknowledged guru in the field. The entry was quite clear — that fractions come about by dividing unity into parts. Thus by definition they are positive.

So, what was I to say to Billy?

Well, there is no reason why Billy could not post a Web page, detailing his observations and engaging other mathematics experts in discussion.

The 'Curriculum Police'

People whom I characterise as the 'curriculum police' exist in most schools and every educational bureaucracy. They have fixed ideas about what should be taught, when it should be taught, and to whom. These people suggest that one piece of information is more important than another, and that things must be learned in a particular sequence. For example, they may suggest that certain content should be taught only at a particular year level.

On occasions teachers say to me that they "need ideas", but this is a slippery slope. Perhaps I will suggest that they use computers to enhance the study of 'dinosaurs', only for them to reply that they can't do that because with this year level they do "rocks and minerals". By telling them what they should teach, I too enlist in the Curriculum Police. Why should we be tied by that kind of restriction, that tyranny of content and sequence?

My father-in-law, who is elderly and knows very little about computers, asked me to explain the Internet to him. I tried the best I could, and he said

"OK, let me ask you this question. Do the children need to know more or less because of the Internet?"

That is a really interesting and provocative philosophical question. I thought about it for a while, and said *"They need to know more, but they need to carry less around with them in their heads. They can pack lighter."* Almost everywhere I go these days my computer can connect to something, allowing me to ask other people for information, or look it up myself.

I often explain to people that there are problems with both the Internet and libraries. The first problem is that you need expensive hardware and software to access them — in the case of the Net you need a good computer, a modem, a phone line and an account; in the case of the library, if you are a child in school you need a Mum, her car and a card. In both cases, the only way that you can get an answer to your question is to ask somebody who knows.

Have you ever spent eight hours going through all the stacks in a library looking for some information and in desperation on the way out asked the reference librarian ... who turns to one of those four books on the desk behind her? The answer is always in one of those four books! The question is why there are not more copies of those four books, and why they need all that other stuff!

It is the same on the Net. How you find information is by asking somebody who you think might know; by approaching somebody working in an organisation which suggest that he/she is likely to know; by posting something on a news group; by looking on Web pages; by sending emails to strangers. The whole notion of encyclopaedic knowledge where you have to know a little bit about lots of topics — and top down curricula — is no longer relevant or practical.

People often misunderstand what this means in practice. Senior administrators will come up to me at conferences and say something like *"You know, the problem with schools is that you have to change the way you do things. You have to make it fun, like computer games or music video clips — that's what we're competing with."*

By contrast, good teachers know very well that the children would rather be with them than with a television set.

What we need to do is make learning more **meaningful**, not just 'fun' ... or at least, as Seymour Papert commented in *The Children's Machine: Rethinking School in the Age of Computers* (1993), we certainly want to make it **'hard fun'**.

If you think about the things you are passionate about — the hobbies you have, for example — they are not easy and fun. They are hard and fun; they are challenging; they tend to get harder and more demanding the more you do them, the more skilled you become, and the higher your expectations become. The problem with things like computer games for the educationist is that they are extremely **process rich**. Children keep maps in their heads; they communicate with each other; they read reference material; they call up Tech Support on the phone — but at the end of it all, they **don't** *know* anything.

Similarly, the endless streams of available CD ROMs are **content rich**, but process poor. There is plenty there to memorise, if that is what you want to do, but is that enough? Companies in this field initially seemed to think that people wanted to sit down and, in effect, read an encyclopaedia. They were wrong. Now they are establishing 'Learning Skills Divisions' — to deliver what is fundamentally no more than what used to be called 'Computer Assisted Instruction' (CAI) ... yet another way to indulge one's fondness for the classics!

If I were a potential employer wanting somebody with maths skills, and you gave me a choice between a child who grew up using Maths Blaster, or one who learned maths in formal maths classes, or one who learned using CAI, or one who used Sonic the hedgehog, what sort of criteria would I use to make my selection? What would I need to know about content and process? In "practical" terms, which child is going to be able to get through the voicemail system at the airline to talk to a human being? ... Or get the car out of the garage after the electric door has closed on it? Or get into the MCG for the Grand Final without a ticket? I think we have to err on the side of process. The technology is levelling the playing field.

Seymour Papert says *"Why quibble?"*. At best we teach one billionth of a per cent of all the information that is available in the world yet we argue endlessly over which billionth of a per cent is most important.

STUDENT-CREATED MULTIMEDIA

In some schools 'Multimedia' has become the 'flavour of the month'. Multimedia is fine as part of a continuum. It is not a discipline. It is not a subject of study. You don't teach 'Multimedia' any more than you teach 'Pencil'. It is media with which to express yourself — more pipe cleaners, if you like, but with video, sound, and excitement — in a way that should enhance what you would do otherwise, in order to craft something of personal significance.

There are popular items of software currently being used in schools which allow students to create multimedia reports. Teachers come to conferences excited about showing the results of how their students spent three months editing a few seconds of video, which they did not film themselves, but downloaded from a disk. Superficial projects in which the word 'zebra' is accompanied by a scanned photo of the animal are hailed as revolutionary.

We need to ask ourselves some serious questions about this. Just because it took a long time to do does not mean it was worth doing. It does not mean anybody has learned anything. Just because it was 'fun' does not mean it was worth doing, any more than just because it was 'hard' means it was worth doing.

It is interesting to see how such software is tending to be marketed — as being 'constructive' and 'open-ended', allowing children to 'express themselves'. Intellectually many teachers seem to love it, because of its capacity for allowing children to make things. However, what the children are making is effectively no more than 'book reports'. The package is a tool which allows you to be as creative as you want, as long as it is what you would have made anyway.

We could spend hours discussing the merits of this. All I can say is that such an approach does not mesh with a style of teaching which expects technology to follow the learner/teacher rather than lead.

Certainly children should be exposed to this kind of activity, just as they should be exposed to other skills. For example, they should be exposed to the skill of 'outlining', but that does not mean they should be forced to write an outline after they have written a paper just in order to satisfy some requirement. They should learn to write an outline when they need to use one. The same applies to the use of multimedia. Children can be taught how to use 'presentation' software packages in no time at all, but should the goal of education be to prepare presentations for the sake of it?

I want children to have much better written and verbal skills. I have no problem with that being achieved through learning to use presentation software, any more than I have a problem with children being introduced to using glove puppets. My problem lies with a real concern about the shallowness of some of the 'bulletpoint' presentations which I see children present. It used to be that you asked them to develop and use note cards to organise their thoughts and expand them into something significant. Now we have electronic note cards with the 'right' transition and the 'right' font. Does that really pass the 'So wha'?' test in terms of valuable learning or expression?

What are some of the other things to bear in mind? Before getting into the area of multimedia, we can prepare for when the technology arrives. I would suggest that before the multimedia hardware and

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> *It is not a discipline.*
> *It is not a subject of study.*
> *You don't teach 'Multimedia'*
> *any more than you teach 'Pencil'.*

software even arrive in the school, teachers should be getting other things under way. Much has already been done, and can be built on. Child friendly classrooms are technology-ready classrooms.

For example, teachers can be auditing, preplanning and developing skills and understandings in:

- Film making

  Every school has a video camera. Some students are already using it to make things. Explore how to use it for narrative, for drama, for recording musical or artistic performances, or for showing how to cook a particular dish.

- Communication

  Children can be given opportunities for learning how to communicate visually with an audience or a variety of audiences and for learning about things like perspective, composition and message.

- Collaboration

  Before working on multimedia — a collaboration between media — children need to know how to collaborate among themselves. That does not imply the use of particular equipment; it implies learning particular skills and processes.

- Quality and value

  Children need to understand that quality work takes time. They need to understand that sometimes it is worth spending three months editing a piece of video, and sometimes it is not; they also need to know why.

  (*Unfortunately, in this context, as I suggested earlier, most schools are still based on a model where students do something between given times, until the bell rings and they move on. Then we complain that children have short attention spans and don't take pride in their work!*)

THE LAPTOP EXPERIENCE

I have been working to develop laptop use with schools in Australia since the earliest introduction of the technology. I believe that the schools going with laptops are just one step ahead of history. The innovators are now able to stand back and assess where they have reached. Some may start to question what has worked / not worked, and what has been worth doing, but clearly the issue of **personal computing** — the idea that the computer is somewhere where I store my ideas, my work and my thoughts, that I can take it with me and use it any time and make connections around the world — is not going away. Australia leads the world in child-centred personal computing.

As I said to a group of administrators, "*If you think it's hard figuring out how to get your teachers to use one computer in the classroom, you'd better get to grips with it, because your students are going to have them coming out of their bags, or their pockets, before very long!*" You can only remain an authority as long as the context allows you to do so. I fear 'educational leadership' may be interpreted as the ability to negotiate the lowest laptop price or the largest software licence, rather than making courageous decisions that improve the quality of education. I believe school leaders should be sharing examples of imaginative student work with peers and the press, to demonstrate educational excellence, and their leadership by implication. An added benefit of keeping 'one's eye on the prize' may be potential cost saving from interschool co-operation in such matters as negotiating Internet access for all their students.

Every child should, in effect, already be living in the 21st century. That is why I like laptops. Children with their own computers are at least potentially liberated in an educational/learning context. Newt Gingrich, Speaker of the House of Representatives in the USA, was the laughing stock of Washington when he suggested to a Congressional committee that perhaps we ought to give laptops to poor children, as one way of enfranchising them and making them more a part of the society. However, what he was saying is fundamentally the same sort of message as Seymour Papert's. When you have two people so much 'at the extremes', but in agreement over an issue, what is the other side?

PROFESSIONAL DEVELOPMENT

Professional development lies at the core of what we will be able to achieve in changes related to technology and broader educational areas. More and more I find myself thinking about how to make this professional development more effective. I have developed a few 'laws' and principles which I think are worth sharing.

Stager's Laws of Professional Development

Stager's 'First Law of Professional Development' is quite simple:

1 *It is difficult to get teachers to learn new things — especially if you never ask them to.*

   This should be obvious, but it isn't. There are many schools which spend a lot of money on technology, without ever really bothering to ask teachers to use it. The first step is to set up some realistic expectations of the teachers and then to support them.

My second law of professional development is that:

2 *scarcity is a major obstacle to use.*

   How many after-school workshops and meetings do you have to go to before you can get a printer ribbon in the same calendar year? … or an extra hour of computer time in the computer lab?

   I read a statistic recently suggesting that 96% of all secretaries regularly use word processors. Where then are the regional offices, or consultant support, or conferences for secretaries who want to learn how to word process better, and become more efficient at word processing? More often than not I suspect that the machine has been dropped on the secretaries' desks and they have simply been asked to do it.

   I suppose the good side of that, by comparison with the teacher situation, is that at least the secretaries were given a computer, and they have come to grips with it as part of their job.

My third Law of Professional Development is that:

3 *teachers in my experience, and in all the literature I have read, routinely identify having the opportunity to talk with their peers as their most valuable professional development activity.*

   You don't need an Act of Parliament for this. I got myself into strife at the World Computers in Education Conference last year with the English Academics, but I hold by my belief that what you need for good PD with teachers is essentially to put them around a table with a bottle of wine, a packet of crisps, and time to talk with their peers. The fact that a lot of schools cannot accomplish this is regrettable.

Having said that, obviously you need to provide a variety of professional development experiences — a balance of residential activities, support for teachers in the classroom, sessions after school, conferences and so on — which are on-going. New staff need to be focussed with their enthusiasm, while they bring in new ideas that can be picked up by other staff. Older teachers need to be fired up again and act as leaders to those younger staff. We need to be realistic about what we have to achieve with professional development, about whom we are going to target, and about how best to do it.

Three professional development myths

1 *The Osmosis Myth*

   This myth is that you will fall in love with the technology and learn to use it by associating it with something you hate doing — the idea that the school can give a computer to the teacher and then tell him/her to write student reports on it, or say "from now on average daily attendance will be computerised, so you will be entering the data for your classes every day." Where is the logic in taking something hard and foreign, making teachers do it, and then expecting success in trying to make them love it?

   I do think, however, that you can help teachers learn how to use a computer while they are doing something you employ them to do, so

long as it is not more paperwork on top of what they already do. The solution to too much paperwork is not a computer, it is less paperwork. What we should be doing is employing our teachers to benefit children, and that is also how we can get them to embrace computers.

2 *The "We can't buy computers for teachers until they know what to do with them" Myth*

Hey folks! It's 1996! In what year can we agree that all teachers should be able to use a word processor? Let's have a date as a goal and have a party when it happens!

I am teaching at a graduate level in the USA, where I am getting 22 and 23 year old Masters students who have never used a word processor. Magazines are writing about how the universities are not preparing their students as teachers for the classroom, and in a lot of cases that is justified, but really, is it not equally legitimate to say that a 22 year old should have been using computers since elementary school? Their primary and high schools have failed them, and too often their university is also failing them. What is our problem in teacher training institutions becomes your problem in schools when you come to hire these young teachers. We need to raise the bar.

3 *The 30-50% Rule Myth*

Currently a lot of press is being given to this myth in the USA, so I am sure it will find its way to Australia. It says that what we really need to do is allocate 30-50% of our technology budget to professional development. No! We need to dedicate 100% of our technology budget for technology. The professional development money must come out of the professional development budget.

Schools value what they pay for. Not only that, but if we spend all our resources training people how to use the 'white' computer, when the 'grey' one comes the response will be that they don't know how to use it. Professional development issues are broader than this. They are based on creating environments which are conducive for learning. We can do broader professional development activities which will help technology 'slide in' to the way we work.

Principles

On the broader level, I suggest that …

- you do better for teachers by making it better for children

- the most important thing you can do is create exciting models that are likely to inspire colleagues

- if you put computers into your school next year, pick a couple of teachers who are likely to succeed — if you have any questions whatsoever about them, pick somebody else for the first year, since you want to have models whom people will want to emulate

- professional development is on-going, and

- don't pander — teachers are employed to provide rich and rewarding learning environments for children, not to do paperwork.

Strategies for success

In practical terms, based on my experience and observations in schools around the world, I also suggest the following strategies:

- *Work with the living and do no harm*

  Concentrate on those people with whom you have a reasonable chance of success. Be open minded in this; it may not always be the person who shows up to every meeting; it may be somebody who's doing wonderful things in the classroom.

- *Stay on message*

  You cannot tell teachers — as I have seen in some schools — that you want them to abide by the traditions of the school **and** follow the curriculum/syllabus verbatim, **and** donate a couple of hundred dollars worth of their own time to rewriting their Year 7 maths curriculum … oh, **and by the way** also find constructive interdisciplinary ways of using laptops in their classrooms. Of course teachers will be confused and angered by that. You also need to be able to articulate the accompanying changes and new expectations to parents.

- *Work on the teacher's turf wherever possible and keep your expectations clear.*

- *Get the teachers away from school*

  Get them to where they can mess about with the new tools and software, where they can fall in love with their new learning, get to know each other better, see what they are capable of doing.

- *Provide adequate resources, especially time.*

- *Avoid the 'Software du jour' syndrome. The best software is 'more'.*

  By software *du jour* I mean the type of reaction that says "I can't do it until Word 74 comes out" … "I'm waiting for that feature in Maths Blaster 97" … "I can't use Microworlds because I need software on Christopher Columbus" (software, by the way, which would probably be used once then cast aside so they can go on to something else).

  Software *du jour* is often a way that teachers, consciously or subconsciously, use to avoid getting involved with technology.

- *Practise what you preach.*

  Administrators need to use the technology too. One of the depressing things that I have noted when running workshops around the world, with perhaps forty teachers at a time over three days, is that the benchmark for administrator participation is about one hour.

  If they find one hour to involve themselves in something that they are expecting their staff to commit themselves to, we need to be sensitive to that dynamic and its implications, for example in staff perceptions of their employers' commitment and support.

- *Understand the power of learning from children.*

  Children can construct their own learning. We have much to learn from helping them in that process.

FINAL COMMENTS

We have an opportunity to make schools relevant, wonderful and exciting — to make them places where children learn and where they want to be. When I talked before about the value of the Internet, one of the questions I was asking that is bad news for teachers was "*Why should I sit in my classroom and listen to you as a "pretend" physicist, when I can get on to the Net and talk to a real one?*"

On the other hand, the good news for teachers is that there are many wonderful things teachers do that are uniquely **human**. We need to find a way of communicating this to the public and make it clear how we are sympathetic to the technology. For example, my students in the USA have constant and ongoing access to me — before they take my course, while they take my course, after they graduate, while I am in Australia, and throughout their working lives.

As teachers, if we can make that human bond — if we can guide our students to knowledge, counsel them and be their colleague — we need to ensure that we find ways to harness the technology to make that process even more successful.

Why should a teacher only have contact with a class for one period a day? We need to act and change in order to have much more flexible environments and opportunities for ongoing lifelong learning — not just make noises about thinking that it is desirable. Why should I, for example, have a seminar audience to talk to only for two hours? Why should they only have two hours to interact with me and with each other? Why should I communicate with readers only while they are reading my printed thoughts from that seminar?

Sending email can overcome such limitations. By visiting my Web site teachers or students can gain access to articles I have written and materials to use in classrooms, as well as links to other places.

Probably most of you reading this are on the right track. You are already taking courageous stands in your workplaces, grabbing the future with both hands, working to make schools better places for children. I hope this collection of thoughts has encouraged you along that path.

A SELECTED READING LIST, AS SUGGESTED BY GARY STAGER

Books and articles that 'you should have read already!'

Feynman, R (1989) *Surely You've Been Joking Mr Feynman*, Bantam New Age Books, New York.

Negroponte, Nicholas (1995) *Being Digital*, Alfred A Knopf, New York.

Papert, S (1980) *Mindstorms: Children, Computers, and Powerful Ideas*, Basic Books, New York.

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Books 'worthy of your consideration'

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'Great education books for you to read this Summer'

Baker, D; Semple, C & Stead T (1990) *How Big is the Moon? Whole Maths in Action*, Heinemann, Portsmouth, NH.

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About the author:

Gary Stager, Adjunct Professor of Education at Pepperdine University, Los Angeles, has been involved extensively with the innovative use of computers in schools in the USA, Australia and other countries. In the course of frequent visits to Australia over the last six years, he has worked as a consultant with a number of schools, particularly in the independent sector, and has been closely identified with the design and development of major programs both for laptop computing and professional development. He has twice been keynote speaker at Australian Computers in Education national conferences.

About the paper:

In this paper, developed from a presentation to an IARTV seminar on a recent visit to Australia, **Gary Stager** offers a provocative, entertaining view of computing and the new technologies in schools, suggesting that the relationship between technology and education needs to be re-thought, and explores the extent to which potential and rhetoric are currently matched by classroom practice. He questions assumptions and myths about technology in the curriculum and argues for an emphasis on using computers in the establishment of creative environments in which students construct their own learning. He discusses the role of the Internet, multimedia, and laptop computing in that context.

About the Seminar Series

This series of papers, by leading educators, is based on seminar presentations.

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