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Pedagogy before Technology: Re-thinking the Relationship between ICT and Teaching

DERYN M. WATSON
School of Education, King's College London, Waterloo Road, London, SE1 9NN, UK.
E-mail: deryn.watson@kcl.ac.uk

This paper addresses a conundrum: despite the ubiquity of technology in the business world, no clear role has emerged in education. After many years of national policies and investment in Information Technologies in the UK and elsewhere, technology is still an imposed and novel 'outsider' in the pedagogy of schools. This paper charts a series of experiences and failures in the UK, and highlights the unresolved dichotomy of purpose about why Information and Communication Technology (ICT) should be used in education. Understanding the problematic of using Information Technologies demands a consideration of some more fundamental educational issues. ICT is often perceived as a catalyst for change, change in teaching style, change in learning approaches, and change in access to information. Yet the rhetoric for change has been too associated with the symbolic function of technology in society, which sits uncomfortably with teachers' professional judgements. So educational computing, it would appear, has yet to find its own voice. This paper explores this notion.

Keywords: ICT and pedagogy; teachers; change; information; knowledge.

Introduction

Technology plays an important and pervasive role in modern business and everyday living. It is associated with an efficient modern society and economic health. The advent of the computer has been hailed as comparable to the printing press; the more recent growth of communications technologies has introduced features such as 24 hour stock market trading; email is replacing the fax. The word 'globalisation' is ubiquitous.

Why has it proved hard for a similar role for Information Technology (IT) to emerge in education? This paper will explore some of the simplistic explanations for this lack of pervasiveness. In addition, the rhetoric and policy focus that is driving educational change associated with IT will be analysed. Using as a case study the activities in the UK educational scene for the last twenty years, I will suggest that understanding the problematic of using Information Technologies demands a consideration of some more fundamental educational issues.

IT is not only perceived as a catalyst for change, but also change in teaching style, change in learning approaches, and change in access to information. Yet research indicates that teachers are both threatened by change, and conversely not impressed by change that appears to focus on what the technology can do rather than on learning. Indeed, with a

continuing emphasis on using applications that were designed for business, and a policy focus on technology as workforce training, it is not surprising that educational computing has yet to find its own voice.

And so this paper will suggest that the cart has been placed before the horse. Yes, IT can change knowledge and the way we access it. But what knowledge do we need in the 21st century? By probing Marin's seven necessary "knowledges of education for the future", I will argue that policies should address the nature of learning and teaching to achieve such knowledge. From this will emerge a clearer template of what change is required in education, and the new expectations and relationships for both teachers and technologies in order to achieve it.

Experiences and Failures in the UK

A series of initiatives

Over the last twenty years there has been a concerted effort to promote the use of computers in UK schools. Alongside other nations, there have been substantial central government initiatives to put computers into schools; major reports have extolled the virtues of using IT in classrooms. From Computer Assisted Learning (CAL) of the early 1980s, to open learning through the use of telecommunications and the Web of the early 2000s, the rhetoric is the same. Information Technology is equated with the modern world, economic success and the future; so schools must embrace the technology.

> These new technologies, and the way they are used, will have a profound impact on every one of us. . . . It will lead to real progress in helping learners throughout their lives and hence help with the vital task of keeping Britain competitive in the 21st Century. (Michael Heseltine, UK Deputy Prime Minister, 1995)

> Technology has revolutionised the way we work and is now set to transform education. Children cannot be effective in tomorrow's world if they are trained in yesterday's skills. Nor should teachers be denied tools that other professionals are trained to take for granted. Standards, literacy, numeracy, subject knowledge—all will be enhanced by the Grid and the support it will give our programme for schools improvement. (Tony Blair, UK Prime Minister, launching the National Grid for Learning, 1997)

Indeed in the UK, the "raising of standards" of teaching and learning has become intertwined with the use of ICT.

> The use of digital technology for improving the delivery of education has enormous potential to raise standards and increase employability. (David Blunkett, UK Minister for Education and Employment, 2001)

The official perspective on the last twenty years is one of success. A series of UK statistical bulletins shows that the number of computers in schools and the number of teachers who report using them has increased regularly since 1980. In 1980 an initiative placed one computer in every secondary school; two years later there were 16. In 1990 the average number of pupils per computer in secondary school was 18; by 1998 it was 8. Ministers refer to "moving schools into an Information Age"; one has even stated:

> We are world leaders in IT at schools, recognising its vital importance to the future of all pupils. The figures show clearly the advances we have made in the field. It is an investment, not only in our children and their lives in the 21st century, but in our country's future as well. (TES: 24.2.95)

And more recently "We are determined to take Britain swiftly and successfully into the Information Age" (Tony Blair, UK Prime Minister; DfEE 1998).

In this time, there have been nearly thirty major hardware and software initiatives: from initial computer and printer purchase, to various laptop, CDRom, and Independent Learning schemes, leading to the launch of a national electronic network for schools—NGfL, providing individual access to all staff and pupils to the Web. To these have been added a range of curriculum and teacher training directives. But each new initiative is launched with little evidence of evaluating or analysing the last (Somekh, 2000). Indeed research reports that the impact of IT on schools, both in the UK (Gardner *et al*., 1993; Watson, 1993; Stevenson, 1997; Williams *et al*., 2000) and elsewhere (Pelgrum and Plomp, 1991; Pelgrum and Anderson, 1999), remains "a resolutely disappointing one" (Bryson and Castell, 1994). There is relatively little work attempting to understand this situation. Most focus on the apparent reluctance of teachers to use IT in their classrooms, relating this to a deficit model of teachers who are characterised as technophobic, or too traditional in their teaching style, or reluctant to adopt change.

An alternative analysis of this reluctance, which I propose here, is that despite the hype and massive injection of funds, UK policy has been characterised by a lack of clarity of objectives. The overriding problem is a dichotomy of purpose. Is IT a subject in its own right, with a conceptual knowledge and skill base; or is IT a tool to be used mainly for the learning of other subjects?

A dichotomy of purpose—conflicting rationales

Most recognise a distinct difference between teaching people with computers, and teaching people about computers. But this difference has become increasingly blurred, until the role of the computer as a learning resource has become subsumed by a notion of Information Technology skills and competencies. Computer science classes, which dominated in the 1980s, have declined to specialist Advanced level groups. Today, computers are used in UK secondary schools mainly for classes doing information skills courses, such as word processing or making Powerpoint presentations. And the subject is now called ICT. The relationship between these classes and the use of the computer to assist the learning of

subjects, such as biology or geography, around which secondary schooling is based, is tenuous. It is as if pupils are taught about the functionality of the component parts of a car, such as steering wheels, gears and brakes, but never actually take a vehicle onto the road for the purpose of travelling from A to B. How has this come about?

The blurring of the distinction between learning about (vocational) and learning with (pedagogic) (Hawkridge, 1990) has been reflected in four policy documents that lie at the core of current national perspectives of IT that now influence schools. The first policy articulation came in one of the national Curriculum Matters series (1989). This set out

> "to help schools devise a coherent strategy for making effective use of IT, both in the enrichment of existing subjects and in learning about the technology itself".

But the pedagogic emphasis came first, as

> "through the use of IT in the curriculum, schools will *also* be helping pupils become knowledgeable about the nature of information, comfortable with the new technology and able to exploit its potential".

Although IT was to be delivered through subjects, both pedagogic and vocational purposes are reflected in the detailed aims; thus using IT is both "to enrich and extend learning throughout the curriculum", and "to help young people acquire confidence and pleasure using IT, become familiar with some everyday applications".

This dichotomy of purpose continues in the first National Curriculum document (1990); teachers are exhorted to use the computer in both roles, but one message, that of IT skills, appears to be more important than the other, that of curriculum use. Indeed, not only are the vocational aspects dominant, they are also narrowly technocentric. For while pupils

> "should be able to use Information Technology to communicate and handle information; design, develop, explore and evaluate models of real or imaginary situations; measure and control physical variables and movement";

they should also

> "develop confidence and satisfaction in the use of information technology; develop the flexibility needed to take advantage of future developments in information technology".

It is less easy to relate these last capabilities to a subject-centred curriculum.

By 1995 it was apparent that the attempt to maintain the dual role of IT, as a tool to deliver the curriculum and as a subject with a skills basis in its own right, was under substantial strain. In the Dearing National Curriculum review, IT capability was characterised by an ability to use IT tools and information sources to analyse, process and

present information, and to model, measure and control external events. It is only necessary

> "to give pupils opportunities, *where appropriate*, to develop and apply their IT capability in their study of National Curriculum subjects".

So the role of a tool to support subject based learning has been reduced to a mere recommendation. The pedagogic notion of CAL has been made more diffuse by the increasingly vocational notion of separate IT skills.

Finally, in the revised National Curriculum (1999), Information and Communication Technology (ICT) is confirmed as a separate subject in its own right, with assessments of attainment at the same four key stages as other subject. But in other respects, the pendulum has begun to reverse; pupils and teachers are also exhorted to use ICT tools and information sources to support their work in other subjects. Thus while the tool is identified as a separate curriculum entity, it still has a pedagogic purpose. Indeed there is another new initiative designed to train and test all teachers to ensure they can utilise ICT tools. And the tools are both standard business-designed word processing packages, spreadsheets and databases, and CDRoms and Web access to a range of information sources, and packages to present text, visual material, and increasingly sound.

So schools still have to grapple with two rationales—one associated with learning the "ICT tools and skills" to reflect the use of ICT in the adult world, and the other to actually use the tools to further the rest of the curriculum. This confusion of purpose has inevitably been compounded by the practical and technical difficulties of implementing a flawed policy in schools.

Reconciling the conflict—the reality of IT delivery on schools

ICT co-ordinators have been appointed in secondary schools to implement national ICT policy. This includes not just tackling hardware and software resourcing, network maintenance and management, and staff INSET, but also reconciling the different perceptions of how, where and why ICT should be used. Nor have they started with a level playing field. Some schools have been active in ICT for many years, resulting in local patterns of use and resourcing highly dependent upon the interests and enthusiasms of particular staff. Because of the dictates of the National Curriculum, it is inevitable that an overriding priority is to ensure that pupils are given opportunities to develop ICT skills progressively as they move through the school. But two issues arise; who is to provide the teaching for these ICT skills and where will it happen?

A common strategy has been the development of the ICT skills courses, which focuses attention and resource on the "vocational" rationale. But Inspectors have reported the frequent mismatch between the intentions behind school ICT policies and their operation in practice. Pupils are often practising low level skills, and there are often insufficient opportunities to apply the ICT skills, learnt in separate ICT classes, to work in other subjects. As Ragsdale (1991) has noted, knowledge of ICT skills do not mean these skills

are always applied. Indeed, acquiring ICT tool skills may be relatively easy but gaining wisdom to use them effectively is not.

Pupils are hampered from gaining such wisdom because they are learning these skills in isolation. It is sad to see pupils use a spreadsheet without a genuine need to explore and model a relationship in the data they are manipulating. They need to learn ICT skills with a real task in mind, and practice them regularly so that they become familiar and taken-for-granted skills to exercise and tools to use. This suggests that they should use these skills regularly in the normal subject based classroom.

So the alternative is for different subject departments to deliver to component parts of the ICT curriculum. A familiar pattern is for history or geography to take on databases, English for wordprocessing, and science or mathematics for modelling. This apparently logical approach has also hit a number of snags. Firstly while subject departments may indicate a theoretical willingness, in reality they find their existing timetable is already squashed with competing curriculum and policy demands. Secondly a number of staff have been reluctant IT users themselves, and have baulked at taking on an additional ICT teaching load. Even for confident ICT users there have been problems. Where geography teachers may choose to use a data base to encourage pupils to pose and test hypotheses about a topic, e.g. population growth, at the same time they are now being asked to teach about data retrieval and ensure that a specific and measurable ICT capability is delivered. This adds complexity and potential conflict of purpose in what is otherwise a clearly geographically focused agenda. There is little doubt that this approach is failing. The new training initiatives are designed to overcome this reluctance. We will not know until 2002 how successful they have been, but past experience does not suggest optimism. Indeed in 2001 the national inspection agency, Ofsted, reported:

> The training for those teachers who have received it (i.e. the new training programmes) has contributed to an increase in their use of computers, but only rarely do the pedagogic expertise to help them make the most effective use of ICT in their lessons (Ofsted, 2001).

In the meantime however another whole agenda has emerged—using the Web as a source base of information, or rather Information, with an emphasis on the capital I. It is here that many teachers and schools see themselves able to reconcile their problem. Using the Web to search for and download information needed for subject lessons will surely satisfy both requirements. But there is a real danger that a fundamental purpose of schooling, to learn to know, is being swept aside by the need to acquire information. Where do the pupils learn the wisdom of how to use information, to challenge its assumption, its sources, indeed the very hegemony of "Information".

Passey (1999) has analysed the learning objectives in the new National Curriculum for ICT against Bloom's learning categorisation, see Table 1.

This analysis shows that the number of learning objectives which are concerned with higher-order learning are far fewer than those of lower-order learning. So, much effort and conflict for relatively little gain. And indeed the inspectors recently reported "For too many pupils the location of information remains an end in itself, and they present the information unprocessed" (Ofsted, 2001).

Table 1. Categorisation of the learning objectives in the ICT National Curriculum using Bloom's taxonomy (from Passey, 1999)

Learning category	Frequency
Knowledge acquisition	13
Comprehension	14
Application	16
Analysis	4
Synthesis	1
Evaluation	4

Compounding the problems of series of national initiatives, a residual dichotomy of purpose, and weak strategies for implementation, there is a further factor, the resourcing issue, which adds to the overall problematic of using ICT in schools.

Location and access

Today most schools have a couple of computer rooms, with other clusters of machines in some subject specialist areas. For many years the type and configuration of hardware has dominated debate on resourcing. But talk of MSDOS, speed of processing, multimedia, and now Internet access has made ICT in schools synonymous with technical matters, and with the associated power base for those "in the know" and who "understand these things". This has been both overtly and covertly damaging (Watson, 1990). Decisions about purchase and computer room layout are frequently made on the basis of technical specification, rather than educational purpose. Not many teachers like facing classes where all pupils have their backs to them, sitting at machines located around the walls "because of the wiring". This compounds a sense of alienation, not being part of the inner circle of those who know about and can use "the machines". This phobia, which teachers do not display in other fields where machines are involved, has developed into a subtle myth. Many teachers own and use computers for their own administrative work, but never use them in their classrooms.

The nub of the matter is of course that they are not using them in their own classrooms–typically they are having to book a timetabled fixed resource and move the class there for a limited time. It is ironic that limited time may be available for the very open-ended exploratory work which the technology can facilitate, but which demands flexibility. It is not the resource itself, but the restricted access to it, that causes the problem. And the amount of time available for subject teachers to book the rooms have been severely limited by the blocks of ICT skills classes. The new emphasis on the Web has led to a shift of location into School Libraries or resource centre. This has facilitated increased access for individual pupils outside class, but does nothing to help the use of ICT as part of your direct classroom activities with a pedagogic intention in mind.

The recent emphasis on the technology for "communication", as a grid for learning, has also embraced the role of technology to enable schools to produce and manage the

increasing statistical evidence required by government with respect to national attainment and standards targets. New networks are being designed principally for these demands. A recent advisory document on ICT planning (Becta, 2000) places substantial emphasis on ICT skills and management efficiency, with little comment on pedagogic purpose. Two schools where I have recently been researching have employed systems managers to handle the technology. Both these managers place the sophistication of the network as their prime goal, and the demands of the senior management team have greater priority than the demands of teachers and their delivery needs.

Schools do not have nearly enough hardware to allow them to plan sensibly for coherent progression in ICT skills used appropriately within curriculum settings. Learning with computers has severely declined in this climate; learning about them, learning ICT skills and seeking and downloading information dominates computer use. In essence, schools are attempting to implement ICT policies that cannot be realistically delivered. Until there is a ratio of 1.25 machines to every pupil, and every teacher has a personal computer on their own desk, all preferably portable laptops, it is unrealistic for schools to be asked to deliver a balanced ICT using curriculum. It is certainly impossible to do justice to the very real and important conceptual issues about the nature of information and communication handling, and their role in society.

In reality, not many teachers are actually using computers with their classes. And more importantly, computers are not contributing substantially to the learning of pupils. The 1989 survey of IT use in schools showed that although half the teachers in secondary schools had been on initial awareness training, less than 25% reported to have made much use of computers, except for in computer and business studies classes. On average less than 10% reported that IT made a substantial contribution to teaching and learning. The 1997 statistical bulletin still shows less than 10% of teachers reported ICT making a substantial contribution to teaching and learning; little change in eight years. The McKinsey (1997) report also makes this stagnation perfectly clear. In 2001 Ofsted reported:

> Only a minority of teachers are capable of managing ICT resources and organising the classroom to ensure that effective subject learning is taking place. Many teachers still have difficulty in deciding when, and when not, to use computers, while others are reluctant to use them at all. Teachers who have had experiences of faulty technology are often sceptical about the capacity of ICT to help raise standards.

Even in Finland, where the technology is fairly ubiquitous in schools, Sinko and Lehtinen (1999) estimate that at best only 20% of teachers use ICT in their teaching. We need to ask ourselves why these innovators remain in the minority.

Educational Change

In the last section, I have argued that the dichotomy of purpose behind policies, the differing perspectives of those involved, and the problems associated with attempting to resource these conflicting demands goes some way towards explaining the problematic of

using computers in schools. Now I want to argue that these are but symptoms of a much larger issue, that of attempting to engineer educational change.

Teachers and change

Fullan (1989) places the teacher at the heart of the success or failure of educational change; but he also asserts that if change is to happen it requires teachers to understand themselves and to be understood by others. Curriculum change theories have generally asserted that once a small cohort of innovators emerge, their adoption of the innovation cascades through their peer group of subject teachers. Yet it is clear this is not happening with respect to ICT in schools; the innovators have remained a minority of teachers for well over a decade.

Research evidence from classrooms in Canada, England, the Netherlands, and Spain (Watson and Tinsley, 1995) suggests that the few teachers who do use computers in their classrooms tend to be those who can clearly relate the use of technology to their pedagogic strategy for their own subject. It is the keen "ICT for CAL" users who manage, despite considerable organisational difficulties, to obtain access to resources and who are flexible in their approach to its use. In particular it is these teachers who recognise and enjoy the pedagogic potential of ICT because it relates to their own philosophical underpinnings about teaching and the nature of their subject (Watson, 1993). They are at home with CAL; they "teach geography (or history, biology, art . . .) with computers" rather than "deliver ICT". They often refer to the open-ended exploratory work that can be generated as crucial. They recognise the way that ICT is actually changing the nature of the subject that they teach. But they are rare. So the success of this innovation, ICT use in schools, resides in the professional competencies and interests of only a few teachers. For them the focus is not a future "information age", but the fact that it supports the nature of the learning in their own subject.

Their colleagues, however, even in the same subject sub-culture (despite one report) (Goodson *et al*., 1991), express caution and articulate barriers which inhibit their involvement with IT. Colleagues find the micropolitics of access too inhibiting, are not confident users of the hardware, and are not convinced of the value (Watson, 1998). They all state reasons that have become associated with failure of IT innovation (van den Akker, Keursten and Plomp, 1992); a lack of good software, or time to explore software, negative experiences in the classroom that had "put them off", and that it is not worth the amount of extra effort required. Williams *et al*. (2000) report that teachers feel they would benefit from more appropriate information and management strategies relating to evaluation and access to ICT resources. Many teachers are currently not in a position to make informed judgements on ICT to support their teaching goals. Clearly a variety of factors still do make using ICT in the curriculum problematic.

Rather than spearhead the adoption of change by others, however, the enthusiasm of the innovators seem to inhibit their colleagues, who identified the innovators as mavericks, different from them (Watson, 1993b). The resulting credibility gap blocks the cascading of skills even within a subject sub-culture, so exposing the myth of the role model as a basis

for change. It would seem that this is the reality behind Fullan's (1991) statement that "In many ways the more committed an individual is to the specific form of change, the less effective he or she will be in getting others to implement it".

Much of the in-service strategy for the adoption of ICT has been structured on the basis that one user will cascade their knowledge skills and enthusiasm to other members of their department. This is a fundamental tenet that lies behind the bottom up, diffusion model of innovation and change. This model has a resource with teachers as it locates change within their practices and beliefs. But as Sarason (1990) has asserted, there are significant differences between initiation and replication, so examples or models of change are often not generalisable.

Teachers use ICT in their classrooms only when it has a particular resonance with their pedagogic and subject philosophy. And yet the same pedagogic subject philosophy supports and underpins colleagues' professional judgement not to use the innovation. The dominant research focus in this field relates the apparent reluctance of teachers to use IT in their classrooms to a deficit model of teachers, who are characterised as techno-phobic, too traditional in their teaching style, and reluctant to adopt change. I claim this is misconceived. I argue instead those who do not yet use IT in their classes do so for sound professional reasons.

Many of these barriers to the adoption of computers in schools are simply specific examples of barriers to change in general (Rhodes and Cox, 1990; Willis, 1993). Willis in particular identifies a number of barriers common to all change but which may have a particular resonance for why "efforts that involve technology may be particularly difficult to pull off" (1993). These include the fact that curricular integration is a complex, difficult to learn process; many educators feel isolated and alone; time to experiment, explore and study innovations is essential but rare in schools; resentment and resistance destroys projects; ownership is critical to success; and administrative support is essential.

Sarason (1990) considers the failure of education reform to be predictable. When pointing to the intractability of schools to previous efforts of change, he asserts that there are power relationships in schools that reforms fail to address. Indeed he maintains there is now an almost "unbridgeable gulf that separates the world of school and the world outside. Schools are uninteresting places in which the interests and questions of the children have no relevance to what they are required to learn in the classroom. Teachers continue to teach subject matter not children". And yet ironically technology is seen as a potential bridge between classrooms and the relevant world beyond.

The symbolic function of technology

It is clear that the national rhetoric for the use of computers in schools is shot through with unresolved dichotomies. But technology today appears to hold a major symbolic function in society, associated with imagery of the new, positive change and renewal, and of economic revival. Papert (1982) and Gates (1996) relate the technology to future images of revolutionary changes to learning and society. From LOGO to the Superhighway, education has been drawn into the confused notions of a technocentric

society (Turkle, 1984, 1996; Mackenzie and Wajcman, 1989). As Bryson and de Castell state, there are a wide range of policy documents that

> . . . urge educators to grapple with the implications of an "explosion in knowledge, coupled with powerful new communication and information processing technologies" and therefore promote widespread "technological literacy". Arguments that enthusiastically promote the widespread implementation of educational computing typically predict that these technologies will (1) facilitate teaching processes, and (2) promote significant positive gains, both academic and vocational, for students. (1994)

Evaluation studies however, such as Cuban (1986) and Bowers (1988), suggest that unreflexive and unabashed optimism about the necessarily transformative nature of new educational technologies is both naive and historically unfounded. Fullan (1991) has reminded us that the focus today on technology is only thirty years after a similar focus on science, which was stimulated in part by the space race and global political needs. Indeed Miller and Olson consider that

> The history of innovation in education should teach us to be cautious about predictions associated with new technologies. However there is something about computers that seems to negate this caution. Whenever computers are discussed, words such as revolution, powerful ideas, microworlds and student empowerment occur frequently. (1994)

A critique of this imposition of a technocentric culture on schools is long overdue. Conlon (2000) proposes two hypothetical visions, the post-modern and the paternalistic, as a basis for teachers taking ownership of their own vision for change. Selwyn (2000) has called for a broader research base to examine educational computing. Ridgeway (2000) has written of the need to be build our understanding on a much firmer evidence base than that currently available. I find most powerful are the arguments of Preston (1992), who claims that a technocentric culture distorts knowledge by processing it as information. A direct relationship can be traced between an instrumental rationality perspective (Giddens, 1985) and the dominance of school training for IT skills with the emphasis on information rather than the knowledge it can impart. Thus I suggest that using the computer to assist learning can be located within a pedagogic cultural agenda where knowledge and reflection are still important. In comparison, however, a technocentric approach, lauding the notion of skills to manipulate information technology, is a function of instrumental rationality. Hence the clear confusion in UK national policy, which results in conflicting senses of education and training, of pedagogy and vocation.

Thus the reality behind the rhetoric reflects not an inadequacy of teachers, but rather their proper professional reluctance to engage in a deeply flawed national rhetoric. Most teachers reject the symbolic functionality of the technology as too removed from the professional purpose of schooling. If the focus should shift towards a pedagogic cultural agenda, there is a greater chance that teachers will selectively consider ICT. A vocational and pedagogic agenda could co-exist and compliment each other, but only with an overt and comprehensive policy that recognises the validity of both and resources schools accordingly.

No doubt that new skills and confidences are required; no doubt that ICT needs to be an integral part of in-service and pre-service professional development. Nevertheless, with a continuing emphasis on using applications that were designed for business rather than for learning, an emphasis on information rather than knowledge, and a policy focus on technology as workforce training, it is for me not surprising that educational computing has yet to find its own voice.

Pedagogy Before Technology

Indubitably, IT has changed aspects of the nature of knowledge and the way we access it. But what knowledge do we need in the 21st century? So much of the debate about technology and education is based on the premise that technology will be the catalyst to create change. As I have indicated, this puts the cart before the horse. It is already perfectly apparent that the way we construct knowledge is even now too embedded in past perceptions of knowledge, schooling and learning. It is worth considering how educational thinking moves within a separate agenda, which is not focused on technology. Technology is but part of a number of changes in society that demand reflection. So I think it is useful at this stage to put the micro and macro problems of ICT and educational change, within a different construct altogether.

"Seven knowledges necessary for education for the future"

UNESCO commissioned a report following an international symposium to discuss "education for a viable future". This is a global concept, but for achievement within the natural organisation of nation states. Based not on past constructs, they started from the notion that the world is likely to be fundamentally different for our children and grandchildren. In his report, Morin (1999) identifies specific areas of knowledge which reflect the nature of society and its needs as it moves into the new century.

1. *The blindness of knowledge*; education has too often in the past presented knowledge as something fixed and static, whereas knowledge changes. Rather than present knowledge as a tool, ready made and immutable, pupils need to learn and understand about errors and illusions, the possibility of revision and the nature of knowledge as a living and changing concept.
2. *The principles of relevant knowledge*; it is a recurring problem of trying to promote knowledge as capable of covering global issues and at the same time registering that knowledge is local and partial. The supremacy of the existing knowledge fragmented into specific disciplines enables us to link understanding to objects and their contexts, complexity and constituent parts. But it is also necessary to develop a perspective across information within the context of the whole.
3. *Teach the human condition*; all aspects of the human condition—physical, biological, psychological, cultural, social and historical—tend to get fragmented in learning within different disciplines. Thus it is possible to lose the overall sense of what it is to be human.

It is necessary to restore the notion of both the unity and diversity of the human condition even if the organisation of the knowledge is dispersed into separate disciplines.

4. *Teach a world identity*; the future of the planet and humans must be forced into the nature of schooling. Much of the history of our planet is overshadowed by oppression and domination of one group over another. The complexity of the planetary crisis of the new century means that all humans will be facing the same problems, consideration of which requires a sense of world, not simply national, identity.

5. *Confront uncertainties*; although science has introduced the notion of certainties, we face a number of uncertainties. Learning must include a consideration of a range of uncertainties in the physical sciences and biological evolution. Pupils must learn to expect and cope with hazards, the unexpected and the uncertain. Abandon the study of past events to determine expectancy; instead study great accidents and events of our time to prepare us for further uncertainty.

6. *Teach understanding*; comprehension is both the means and an end for communication, but teaching of this comprehension is not currently covered in our schools. And a mutual comprehension between people, strangers, those of different forms of society is essential. Incomprehension lies at the root of racism, xenophobia and contempt.

7. *Ethics of humanity*; teaching should bring about an understanding of the complex human condition, to be an individual, a member of society, and a citizen of the earth. Not through the formal teaching of morals, but through the encouragement of different individuals to also be part of communities and the human conscience. The essence is to broaden the sense of identity towards a planetary community.

Thus we should plan for the nature of society we would aim for—a society of democracy, equity and justice for all, a society at peace and in harmony with its natural environment, a society that can think as one as well as within its constituent parts. The "seven knowledges" emerge both to challenge our existing constructs of disciplines, suggest a re-positioning of our perception of the "known", and move education into central position in the way humans learn to adapt to change and uncertainty.

Educational change as a context for ICT

Morin's report is not meant to be a guide for learning, but rather the framework upon which discussions about learning and pedagogy should take place. We must ask ourselves how should education be transformed to respond to Morin's agenda?

I argue that we need to re-frame the ideas of intervention itself away from the technological model. What is needed is an intervention of educational philosophy and debate. Teachers themselves must contribute to this debate, one for which they are both well suited and informed. At one level they are often already re-casting disciplines into topics, and increasingly teaching competencies of analysis, evaluation and synthesis rather than simply fixed skills; both of these lie at the heart of a micro-analysis of Morin. At another level, the role of teachers in such an environment is "preserving fundamental values and maintaining accessibility of knowledge and education as a social service" (Cornu, 2000). Where could ICT contribute to such a vision for education?

For me, two issues emerge. Firstly such a perspective will serve the value of ICT better than the current technocentric focus. With the rapid changes to the capabilities and directions of the technology, too much attention is focused on the actuality of the new rather than their function and implications, on the development of lower-order skills rather than higher-order learning, and on Information. This has obscured its educational potential. Morin presses the human base of diversity not uniformity; but globalisation as perceived narrowly within the technological frame suggests uniformity. ICT is already re-shaping our knowledge of our world and of different disciplines; it is impossible to imagine geography today without satellite imagery. Even in the early days of educational technology, it was apparent that CAL could stimulate collaborative learning and discussion through role playing, decision-making simulations (Watson, 1987). And the fact of ICT enabling access to large amounts of data is relatively uninteresting compared with furthering opportunities to learn to select, evaluate and analyse information with discrimination, learnt from critical use and leading to an understanding of issues of validity, currency and veracity.

But secondly, this perspective re-positions technology not as the catalyst for change, but rather its tool. Developing a philosophy, a rationale that is fundamentally societal and pedagogic, means that the vocational will naturally fall into place. Re-thinking the position of ICT should allow teachers to be more comfortable with, and contributors to, a purpose which accords with their professional self. Policy makers will still have to address issues of skills and resourcing: there will still be many constraints to change at a number of levels. But to re-frame ICT policy within the process of educational debate and change will offer a greater chance of success.

Attention inevitably and necessarily falls on the specifics of technological innovation, new developments and good practices. But I propose that policy makers and teachers need to address "intervention points" conceptually, and not simply as points in the educational system. For we need to intervene with educational ideas, not simply technological ones.

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