Guidelines for good practice: Integration of information technology into secondary schools

BY IAN MACKAY-SCOLLAY
Department of Computing, Perth College
ECAWA ACCE Representative

BACKGROUND
The International Federation for Information Processing (IFIP) is an international association which explores issues encompassing Computing, Information Technologies and Informatics in all areas of society. IFIP has several working groups. Working Group 3.1 (Informatics Education at the Secondary Level) was established in 1966. Its mission is to view, from an international perspective, the development and impact of informatics and its application to secondary education.

This working group aims to gather the most recent information on international research and practice related to information technology and informatics in secondary education. Information is disseminated through conferences and workshops. On the basis of this collective information and the expertise of the members of the working group, ideas can be shared on the development and impact of informatics and information technology in secondary education.

The scope of the working paper under review (Guidelines for Good Practice: Integration of Information Technology into Secondary Education) is to explore and report on current literature investigating the use of information technology as pedagogical instruments.

This review examines the influences of these tools on the content and methods of teaching and learning.

OVERVIEW
The issues raised by the working paper are:

- forces for change in society and the modification of the curriculum;
- that integration of information technology into secondary schools should take account of human, organisational and management factors as well as curricular concerns;
- that there is a strong technological push in several areas, for example

multi-media, rarely takes into account the fact that hardware and software are frequently unavailable or inadequate;

- technology-based development requires a solid funding base; and
- awareness of equity implications, such as gender, in relation to opportunities offered by information technology.

SOCIETAL CHANGE FORCING CURRICULA CHANGE
Secondary schools have redefined their responses to society's need for education to produce students who can make their mark in the increasingly technological world. At the same time, schools are exploring and implementing information technology applications for pedagogical advantages that are derived from the technology.

The evolution of information technology in schools has been one of the most challenging issues to confront school management in recent years. There are no signs of this issue being swept aside, especially considering factors such as technical advances, economic availability and experience gained in its evolution.

There appears to be no school where information technology tools have been fully integrated across the curriculum. The paper explores the current situation in secondary schools and the problems faced in achieving true integration of information technology.

THE ROLE OF INFORMATION TECHNOLOGY IN EDUCATION
Social, economic and individual implications of the role of information technology in education are viewed as more than a mere teaching machine. The rationale expressed by the paper lies in two areas:

- global culture is tending towards a symbiotic relationship between information and information technology; and

- the culture of students, values, abilities, knowledge and skills, has to incorporate the fundamental life skills required for a technological society.

Abilities to process information (text, numbers, graphics, sounds, video and abstract constructs) will undoubtedly advantage students who possess technological competence.

There is clearly a demand in technologically advanced countries for people with highly developed skills. Conceptual and communication skills are central to increasingly knowledge-intensive economies. Secondary education should aim itself to provide these skills.

Information technology competence used to mean 'computer literacy' or 'computer awareness'. A new approach is seen by the authors as an emerging pedagogy directed towards understanding information and its manipulation instead of one directed towards acquisition and retention of factual knowledge.

The paper postulates that if properly organised and managed, students can 'live' technology at school:

Living a technological culture at school, properly integrated into an innovative curriculum which stresses initiative, problem solving and an open mind for change, could be the most fundamental way to respond to the new requirements of the workforce and the demand for lifelong and transferable skills and competencies. (p. 9)

INTEGRATION
Integration involves utilising the computer as a tool to teach material in a discipline and also in the existing curricula to promote problem solving and higher level thinking skills. The power of information technology tools can be applied to facilitate decision making, to amplify concepts, to support synthesising. It is — 'the process of applying the power and ability of the computer to learning in every subject level' (p. 14)
ISSUES IN INTEGRATION
The following factors were identified by the working paper in influencing the integration of information technology into education:

- Curriculum
- Teachers And Teaching
- Students And Learning
- School Policies And Organisation
- Computer Hardware
- Funding
- Equity.

In the opinion of the reviewer, Australia seems to have no clearly defined relationship between the general aims of information technology in education and secondary school curricula. This situation is one of the main problems prohibiting successful integration.

It is suggested by the paper that a high degree of integration needs an explicit management policy and structure at the school level, as well as sufficient support, training, and time. It must take into account the provision of coherent student experiences in primary schools to facilitate a smooth transition to secondary school.

TEACHER DEVELOPMENT
Information technology-based innovation requires changes in teachers' skills, knowledge and attitudes. The paper therefore contends that lasting changes to teacher development will only take place if the inservice development is continuous and is supported by an appropriate organisational context.

The tenor of the paper would suggest the view that teachers, as human resources, will not derive benefit from short term punctuated sessions, but rather from training plans that are flexible; have a modular structure; rely on well developed learning resources and use the same hardware and software resources available in the school.

The paper asserts that successful teacher development of the integration of information technology into the curriculum can be characterised as follows:

- priority given to discussion of the relationship between the use IT, curricular goals and student activity;
- attention given to organisational factors and teaching strategies. These should be employed by the teacher to use teaching skills most suited for the integration of information technology into a variety of disciplines and classroom settings;
- teachers should be provided with models, examples on the use of various computer applications;
- Training should be given using application packages and well-produced educational software;
- technical jargon should be avoided; and
- training should be resource based, school-based, pedagogically flexible and allow collaborative work.

As a logical extension to the points above, teacher support, as opposed to operative or technical support, provides for innovation and stimulation as well as helping the teacher to develop their role as the main agent of change. Confidence is increased by peer to peer support and support from experienced teachers in informal sessions. Make Provision for teacher support should be part of the school policy.

CROSS CURRICULA RELEVANCY
The paper suggests that information technology is currently taught in many schools as a special subject or as a programme of lessons. Schools find this is the only method of providing a level of competence for all students. Students ought to see the use of information technology tools as a normal part of productive working life. Flexibility of information technology resources is more important than their quantity.

As a corollary to the above: Information technology interlocks all facets of adult work and schools should reflect this reality.

It is assumed that students who are taught a problem solving approach in one discipline using computer tools will automatically employ that approach in other subjects. According to the working paper this is not the case. Students need to be taught general problem solving approaches using computer and other IT tools. It is difficult to teach these general skills within the confines of secondary school subject boundaries.

STUDENT BEHAVIOUR
There is a danger of computer tools promoting individualistic behaviour (the one computer per student ideal). It is therefore recommended by the authors that co-operation and collaboration be encouraged when students are given IT related tasks.

Group work not only promotes the use of IT skills but also important social skills.

Projects aimed at fostering student initiative and critical thinking allow for a move to more independent learning [a distinct trend in Australian education]. Such a teaching style requires specific teacher preparation as well as school organisation and the availability of a wide range of information and computer resources.

INFORMATION SKILLS
Information skills, and more specifically, information retrieval from on-line and CD-ROM based databases are seen by the authors as an important issue. These skills allow students to develop initiative and choose directions which are interesting and relevant to them. Use of on-line databases changes the role of the teacher as an information provider to one of a guide or co-learner. As a result of these activities students can, in the opinion of the reviewer, develop evaluation skills and contribute to the development of their language skills.

The issue of student use of hypermedia based information sources that allow non-linear searching and evaluation has yet to be formally addressed, but will require in the view of the paper further investigation. The way secondary schools address issues of classroom integration and school organisation of information technology resources will be greatly influenced by students' use of IT tools to compose, illustrate, animate, and add sound and video to their reports.

PORTABLE COMPUTERS
In instances where laptop computers (of mediocre performance) have been provided for student use, specific classes or year groups were selected. Research on the long term educational effects of portable technology has been inconclusive.

SCHOOL POLICY
The authors suggest that the following questions are borne in mind when framing a policy on the use of IT in schools:

- Methods used when updating school leaders regarding the educational potential of information technologies.
- The IT impact on the curriculum, teaching methodologies, classroom organisation, school organisation and evaluation procedures.
- Maximum benefit for the students in their progression of IT knowledge and skills.

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• Maintenance of IT resources at affordable levels within the context of a realistic timeline for development.
• The existence of external evaluation and assessment for judging success of IT programmes.
• Establishment of an IT committee representing key personnel in the school community.
• Institution of a structure for teacher development in the area of IT.
• Stimulation of teacher participation in IT programmes.
• Relationship of the school's management information system to IT-based educational developments.

Other areas of concern are:
• selection of hardware/software
• quantity of resources
• flexible distribution of resources within the school
• publicising the inventory of the school's computing resources
• equipment maintenance and technical support structures
• funding for hardware/software acquisition and renewal.

It seems clear from the above points that there should be an explicit policy regarding long term educational aims related to Information Technology.

IT CO-ORDINATORS

Many schools appoint an IT co-ordinator or computer co-ordinator to cope with the problem of integration. That person is usually responsible for:
• co-ordination: computer laboratories, computing resources used by teachers, and computing related subjects;
• technical: support of teachers, maintenance of equipment, software installation and documentation;
• promotion, pedagogical support and collaboration with teachers;
• administrative tasks involving IT resources - planning, budgeting, timetabling and implementation of IT related equipment; and
• teaching IT related subjects.

It has been found that the status of the IT co-ordinator varies from school to school. Research suggests that in most schools the person is an enthusiast who copes with the problems without having a professional status. Where a school is working towards the integration of information technology across the curriculum, the person is often a member of the senior management team.

By extension, therefore, IT co-ordinators should have a broad view of the curriculum and the educational goals of the school.

LOCATION OF IT RELATED RESOURCES

The debate still rages around the distribution of computing equipment - whether all computers should be installed in one location (laboratory) or placed individually in several classrooms. The later strategy allows use in a demonstrative capacity or by a few students in resource mode.

The paper proposes that schools need to determine a specific policy to address the balance between centralised and decentralised resources.

NETWORKS

Although networks are becoming increasingly common in business and industry, schools have yet to be convinced of their appropriateness in an educational setting.

SCHOOL INFORMATION CENTRES

In many countries school resource and information centres have progressed from libraries as the desire to integrate into the curriculum information needs of teachers and students. Traditional sources of information (books, magazines, encyclopaedia etc.) have been augmented by audio and visual materials. More recently, computer based multimedia systems as well as telecommunications systems offering remote information retrieval services and electronic mail facilities have extended the resources available within the resource centre.

The working paper declares that this varied range of services has challenged schools and teachers to alter their pedagogical approach and allow for more student centred learning.

HARDWARE CONSIDERATIONS

The authors postulate that the rapid rate of existing and emerging hardware technologies has made planning for future resourcing an exercise fraught with uncertainties. The problems associated with implementing IT hardware that will have a long useable life centre on the issue of 'industry standards'. These standards either exist for years or fall by the wayside after only a few months, as frequently occurs.

SOFTWARE ISSUES

In the opinion of the contributors, application packages such as word processing and desktop publishing programs, should be available to all students and teachers. The applications ought to be few in number (one word processing package etc.) and of an industry standard.

In the past, government bodies or extensions to government education instrumentalities throughout the world have been one of the main sources of educational software. It was perceived that commercial producers of this type of software were out to seek short term returns by marketing popular programs of doubtful suitability for secondary education.

More recently some companies with a longer term relationship with education have written a variety of programs based on sound educational principles.

Highlighted by the paper, is a new category — Multimedia development tools. The use of these tools should be considered by schools. Multimedia programs allow teachers and students to produce electronic publications which integrate the use of text, graphics, video and sound into assignments, reports etc.

FUNDING

It is hard to gauge whether there is justification for the large investment schools are making to IT hardware, software and professional development. However the paper cites promising research that measures factors such as students' study habits and positive attitudes to IT.

EQUITY ISSUES

Gender differences in IT attitudes, opportunities and involvement at secondary school level is a growing concern. These differences deserve special attention in research and teacher awareness. (p. 43)

The origins of the difference lie in the division by society between work and academic orientations according to gender.

There is also evidence for large gender differences in the use of information technology by teachers and students ... which indicates a lack of progress on gender issues. (p. 43)

The working paper cites studies which postulate that access to computers at home by boys and girls forms a
Learning, teaching and a role for technology

BY GEOFF CUMMING
Department of Psychology, La Trobe University

Learning is conceptual change, and the really important things in education happen in learners' heads. It is simple to state such bits of contemporary ideology, but how can we keep them to the fore when issues of software, finance, information dissemination, staffing, and a hundred other things are so difficult and pressing?

Enlightened contemporary wisdom on university teaching does keep a clear focus on student learning—conceptual change in particular. Ramsden (1992) gives a powerful statement of this position: the teacher's job is to know about student understanding at the start, then to foster its increase, monitoring progress all the while. Active engagement by the learner is vital, as is the chance for interaction so that misconceptions can be challenged and progress recognised and consolidated. Ramsden, however, gives short shrift to computers—it seems especially easy to use technology to perpetuate the bad teaching practices he criticises so vehemently.

More recently Diana Laurillard, in Re-thinking university teaching: A framework for the effective use of educational technology (1993), gives a more detailed and optimistic analysis. Her first four chapters are especially interesting; here she sets out a view of learning intended to underpin the development of good uses for technology. As Dewey, Vygotsky, and many others have argued, active engagement of the learner is needed. Constructionism, situated cognition and cognitive apprenticeship are therefore appealing and popular.

The essence of academic knowledge, however, is that it is abstract, disembedded, symbolically expressed. Grounding in contexts that make sense to the learner is important, but just as important are more general theoretical formulations. Learners must be able to operate in both worlds and, crucially, to map between the two. Learning by experience and construction is fine, but learners are also discovering an intellectual world in which understanding has been cumulating over many centuries.

MEDIATED LEARNING
Laurillard proposes a model of 'mediated learning' that brings together activities, interactions and understanding at the two levels: concrete task and symbolic generalisation. She discusses Instructional Design, Intelligent Tutoring Systems, Instructional Psychology, and Phenomenography in the course of developing the mediated learning notion into a teaching strategy. Ideas and results from cognitive science contribute. The analysis is admirably broadly based, and useful suggestions for research emerge.

The proposed teaching strategy is based on a dialogue between the learner and a teacher or other entity. The learner as well as the teacher expresses conceptions, and each party can comment on the other's formulation and offer a reformulation. The discourse embraces activities in the immediate context and also theoretical descriptions. (Later, on p. 173, the 'task level' and 'description level' of interaction are identified; these can be compared with the task and discussion levels of Cumming & Self, 1990.) Laurillard's teaching strategy may seem idealised, but will be recognised by reflective teachers as a justified ideal.

THE NUMEROUS TEACHING MEDIA
In Chapters 5-9 this teaching strategy serves as the reference for an analysis of a wide variety of teaching media, from lectures, print and television, to tutorial programs, microworlds and computer-mediated conferencing. Many examples are examined. Any discussion of media risks losing focus on learning; the mere vehicle must not receive more attention than the learning
interactions it can support. The end-of-chapter checklists have the advantage that we are forced to consider every facet of the teaching strategy as we evaluate one or other teaching medium. (Twelve questions are asked, the most demanding of which are: Teacher can set up world to give intrinsic feedback on [Student's] actions? Student can modify action in light of feedback on action? ... S can reflect on interaction to modify redescription? T can reflect on S's action to modify redescription?)

The disadvantage is that each question gets a simplistic Yes or No answer. The discussion makes clear, however, that reality is more complex than this, and also that realising the potential of a medium is usually no simple matter.

The teaching strategy specifies that the learner can expect analysis and evaluation in response to the expression of a conceptualisation. Can a computer give appropriate comment in response to input expressed in ordinary, or somewhat constrained language? There is considerable and probably over-optimistic discussion of this enduring question. Using keyword and template recognition to analyse input, and pattern-filling to generate output can enrich CAL somewhat, but exploitation in education of more advanced natural language understanding by computer is for the future. Laurillard reaches, however, the inevitable conclusion: 'Every medium has its strengths ... but each needs to be complemented by a teacher—student dialogue, and that is undeniably labour-intensive' (p. 178).

The more general conclusion emerging throughout the innumerable analysis of teaching media is that a piece of technology can support only some aspects of the interactions demanded by the model teaching strategy. Hypertext and multimedia, in particular, show up as lacking important discursive and interactive properties. Microworlds and modelling tools are given more ticks in the checklist but even here supplementary notes and discussion with a teacher are likely to be needed. We need to build not just some computer materials, but a full set of learning materials and procedures, selected parts of which may be computer-based.

Intelligent Tutoring Systems are given a full column of ticks—they have the potential to provide all aspects of the model teaching strategy. The problem is that the potential remains just that, although the importance of the research field of AI & Education is recognised. Laurillard berates the field for making 'little reference to learning theory or to findings in student learning research' (p. 162), but it is pleasing to note that recent developments make this criticism less justified than it was at the time of Wenger's (1987) review cited by Laurillard; see, for example, White (1993).

DEVELOPING MATERIALS

Chapters 10–12 take a more conventional shape in discussing the design and development of materials. Needs analysis, learning objectives, interface, costs and logistics receive attention. The importance of the context in which the materials are to be used, how they are intended to fit in with a whole course, is emphasised. The last and longest chapter addresses the practicalities of multimedia development. It contains much good sense; for example, including an emphasis on effective project management, but is of general applicability: only within the UK is there likely to be great concern with the precise role for the National Funding Council.

A BASIS IN PEDAGOGY

Laurillard's major contribution is an analysis of learning, and a model of teaching likely to promote the learning she identifies as ideal; and the use of these to explore how educational technology can be used more effectively. The teaching model may seem ambitious and over-optimistic, and insufficiently specific in particular cases, but it is hard to argue with either its justification or its desirability.

On any number of points in the later chapters you will want to argue with the author's stance, but then you realise that, even so, you are arguing on the basis of her own analyses of learning and teaching in the earlier chapters. Similarly, the details of available media and of materials development processes will change, but the analyses of learning and teaching are likely to prove much more durable. This book can help us focus clearly on student learning, and so can help us exploit technology more effectively as we seek to provide our students with opportunities for learning.

REFERENCES


Global networks: Computers and international communication

BY MICHELLE WILLIAMS
Queensland University of Technology

ABOUT THIS BOOK
This book is about what happens when people are connected by global computer networks and what is happening to the shape of the world as networking becomes an integral part of living, working, learning and citizenry.

In sharp contrast to the plethora of 'what is' and 'how to' technical discussions of networks in electronic and print forms, this book examines the social, cultural and political perspectives of networking and helps readers examine the assumptions and implications of connecting people together in the virtual electronic spaces created by computer networks.

The book is essential reading for educators who use computer networks for teaching and learning and for their own professional and personal purposes. The pathways through the book invite readers to transform their understanding of the influence of global networking and to understand that we have neither defined all the issues nor examined them thoroughly. These challenges, and more, are being confronted by the first wave of travellers and settlers in the global networks’ (Harasim, p. 9).

This book is a testament to potential of network spaces for sharing ideas and enriching the lives and work of people. The creation of the book was determined by the electronic community which formed within it. In this community, which came to be known as the Global Authoring Network, GAN, each of the 21 contributors shared drafts of writing, helped to build the arguments and visions of contributing writers and enriched the unity of ideas and experiences woven into the chapters of the final product. The cohesive development of ideas and associations between interrelated themes are testament to the process of networking which emerged by the shared experiences in the GAN.

THE THEMES IN THE BOOK
Networks as place
Early in this book Linda Harasim establishes the concept of networks as being a socially constructed place. Computer networks are not merely tools whereby we network; they have come to be experienced as places where people network: A virtual world’ (Harasim, p. 15). In doing so she explores the notion of a 'network' a place which contains communities of people united in purpose. Contributors to the book focus on the social interactions and communication patterns of people in networked communities examining the dynamics of places like learning circles (Reil), electronic classrooms and learning societies (Teles), networkplaces (Shapard & Feenberg), global villages (Mason), cafes and community wells (Rheingold). These writers pay particular attention of the need to apply human creativity when shaping the internal contours of the networks and to do much more than apply existing ideas to new spaces.

Networks as communities
In promoting the theme that global networks merely provide the technology for people to connect, most contributors to this book extend Harasim's concept of 'networks' to capture the community dynamics in the virtual places where these communities meet. Harasim raises the ideas that communities can be shaped to improve human communication to form new cultures with new purposes. Quarterman raises the theme that communities enabled by global networks transcend national, organisational and time boundaries to form global matrices of people which have collective power and potential to shape world events.

These and the other writers encourage readers not to frame virtual communities as clones of face to face groups nor to adapt existing ideas of community to online networlds. Readers are encouraged to examine ideas from a fresh perspective. For example, the book provides case studies which examine the new relationships between learners and teachers, managers and workers, Governments and citizens which are remapped or reframed into the virtual communities created on global networks.

The book does not shy away from some of the more complex questions emerging from the nature of virtual communities. Rheingold asks: Is telecommunication culture capable of becoming something more than what Scott Peck (1987) calls a "pseudo-community", where people lack the genuine personal commitments to one another that form the bedrock of genuine community? (Rheingold, p. 60). This book defines the questions that networld members will examine as global networks become an increasing part of our lives.

Boundary blurring capacity of global networks
Any time, any place communication and the ability to link people across cultural and geographical boundaries is common thread in dialogue about global networking and computer mediated communication. This book while recognising the boundary blurring potential of global communities brings attention to issues which international global computer networks have redefined. Branscomb describes a global electronic community as a social construction which creates its own rules, customs, ethics and laws.
which transcends national boundaries and international jurisdiction. In Global Networks, Branscomb, Harasim, and Kirby and Murray raise the issue of responsibility of network governance, dealing with particular issues of information property, information security and impact on social stability, pointing out the paper based customs and strategies no longer apply in the new electronic spaces. The discussion by these writers will provoke many ideas for teachers of computers studies.

Overview of contributions
The contributions in Global Networks are organised along four perspectives.

1 Overview: From technology to community
This first part of the book by Linda Harasim examines the social nature of networks and how they have become the new environments for business, educational and social communication. John Quarterman explores the notion of how technology becomes community and Howard Rheingold describes what it is like to participate in the WELL, a well known online community.

2 Issues in globalising networks
This section of the book examines policy, organisational and cross cultural issues which are emerging because of and around global communities. The impact of networks on work and structure of business is explored by Lee Sproul and Sara Kiesler while Marvin Manheim focuses on how organisations use communications technology to gain economic advantage in a global market place.

Anne Branscomb identifies some legal and jurisdictional issues while Michael Kirby and Catherine Murray look at the new international initiatives that are required to harmonise international laws threatened by global networks. Horoshi Ishii examines the importance of cultural issues in network design and Jan Walls describes a case study of cross cultural links.

3 Application of global networking
Part 3 presents a number of case studies of global networks changing learning work and social patterns. Andrew Freenberg describe the use of networking between in the Western Behavioural Sciences Institute of executives from 21 countries of Europe. Robin Mason looks at the impact of the European Village. Margaret Reil examine how leaning circles were used in the AT&T Learning Network. Beryl Bellman and colleagues discuss building a network in North America, Latin America and Africa to forge links between academic, social development and commercial interests. Jeffrey Shapard's chapter explore the use of network tools to remove barriers of language differences in Japan. Lucio Teles shares his experiences at using telementoring principles over networks as means to promote cognitive interactions in education. Howard Frederick presents a case for the emergence of a global civic society which sits beyond national borders in the cause of peace, human rights and the environment.

4 Visions
This final part of the book looks at the concepts, goals and concerns which should guide us into the future. To do so Mitchell Kapor and Daniel Weitzner set out a vision for an International Public Network which is based on equity of access principles and is a network created for people by people. Shumpei Kumon and Izumi Aizu present a case for co-emulation as a strategy for developing a global hypernetwork society of the future while Robert Jacobson takes a individual perspective considering the challenges and possibilities of individuals contemplating life in cyberspace. The final chapter by Linda Harasim and Jan Walls concludes with a look at the role of networking in the creation of this book.

RECOMMENDATION
Global Networks provides new and experienced networld explorers with a range of tools to understand the social, economic and political implications of connecting people with global computer networks. It provides the teacher and university lecturer with a lens through which issues common in computer studies curriculums can be framed and provides communications specialists with a way to re examine their work. However the variety and scope of contributions will appeal to a large audience and provide interesting questions and ideas for all users of global and local computer networks. Highly recommended.