Some national and regional frameworks for integrating information and communication technology into school education

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ABSTRACT
Integration of information and communication technology (ICT) has become a priority in national educational policies worldwide. Meaningful integration requires a number of pre-conditions such as economic opportunity, political will, availability of suitable equipment, support infrastructures, professional development and others. Meanwhile, schools are computer-deserts compared to homes and work-places in Australia as elsewhere (Moursund & Bielefeldt, 1999, p 5). The author examined the dichotomy between school-based educational computing and the potential of home computers for learning by interviewing ICT policy-makers in several countries.

Policy for ICT in education has generally been justified by reference to expected economic benefits, either by improving the efficiency of education or by more adequate preparation of students for the world of work. The implementation of cross-curriculum ICT frameworks in England, the USA, Canada and Australia has taken a variety of different, and yet similar, paths. The broader perspective reveals a commonality of three distinct phases for computers in education. Most countries are concentrating on the second of these phases, but there appears to be much activity leading to the third phase in which the home computer could be a crucial ingredient.

This paper concludes by discussing national progress towards a third phase of educational computing in terms of apparent readiness and current initiatives.

Keywords
Curriculum frameworks, Information and Communication Technology, Schools, Phases

Background
Over the past twenty years, computers have become commonplace in most Australian schools, as in many other countries. As students have been introduced to the new technology, a diversity of approaches have been used to integrate this experience into the curriculum. Some of these were reported in Fluck (1995), which compared the British national curriculum with the Common and Agreed National Goals for Schooling in Australia. The areas of learning produced by both processes were remarkably similar, but their approach to information technology was very different.

The ideas in the 1995 paper were subsequently refined and extended by the Computer Education Discussion Group at the University of Tasmania, and published as the KITOs (Key Information Technology Outcomes for students). A commentary on this was presented at the 1998 Australasian Conference on Computers in Education (Fluck, 1998).

Following the Adelaide Declaration on National Goals for Schooling in the Twenty-first Century (MCEETYA, 1999), there has been an increased emphasis on the information technology skills of students. Recent studies such as 'Real Time - Computers, Change and Schooling' from the Department of Education, Training and Youth Affairs (Meredyth, 1999) have shown that Australian students generally develop their IT skills at home, and are more proficient than most of their teachers. This could be because teachers face great challenges in successfully integrating computers into the educational process, especially resourcing.

The author has undertaken further research into the ways in which various nations and more local areas have implemented curriculum change in this area, by interviewing individuals involved in both development and implementation in November 1999. This paper summarises these conversations, and identifies the major components of national/state approaches in England, USA, Australia and Canada. The contribution of the Department of Education, Training and Youth Affairs, Canberra, and the Council of Ministers of Education, Canada in facilitating this study is gratefully acknowledged.
Developing a national or regional approach

There has been a surprising amount of uniformity and shared concerns when discussing the ways in which individuals and groups have steered their national policies. Most people interviewed told their stories in the political and economic context of their own situation. However, their personal objectives in assisting the development of better use of computers in the classroom stemmed largely from a belief that this would improve student education in a broad sense. In hindsight, some of the decision-makers consulted acknowledged they were not able to accurately foresee major technological developments, such as the Internet. Pressured by Treasury for economic justifications of proposed expenditure, they would respond with increased educational effectiveness or career opportunities for students. But perhaps their truer goal was the potential for children to become more, to have a higher levels of personal aspiration, and to enjoy better access to opportunity or experience.

In some legislatures, curriculum change is achieved by consultation and central direction. In others, the process is much more school-centred (or even teacher-centred) and commonality is difficult to find. In the range of countries studied, responsibility for education was distributed in different degrees between central government and local government tiers. With respect to information technology in education, the traditional shares of funding and policy setting were not preserved, with central government taking a much higher role in both resourcing and policy development than in most other areas of education.

In the United Kingdom, the National Curriculum has gone through two revisions since its introduction in 1989. The objectives of the people involved in the original version were laudably wide, and were stated in strictly non-computer jargon. Students were expected to communicate and handle information, model real and imaginary situations, use information technology (IT) for measurement and control, and have knowledge of applications and effects. This was to be done in a cross-curriculum context, giving computer coordinators a sensitive role that appeared to expect them to enter other subject classrooms to verify student IT achievements. This was an invidious position, and was one of the difficulties encountered in implementing such a wide set of objectives. Because of these tensions, in the 1995 revision, IT was moved out of its component position within the Design and Technology Area, to become an independent area of the curriculum. Objectives were simplified to communicating and handling information and controlling, measuring and modelling. However, the individuals responsible for implementing this change, acknowledged these broad aims were not ones teachers in schools could readily interpret and use in classrooms. Not until a comprehensive series of guides linked the broad aims of the IT area to conventional subject areas was there a reasonable uptake of the revised aims.

In the United States of America, a national approach was engineered by a private sector teachers’ organisation. With a limited amount of seed funding, the International Society for Technology in Education (ISTE) attracted sufficient research and central government funding to undertake a 4-year program of consultation. With previous connections into the teacher accreditation process, the group was able to draw up a program that projected the development of standards for students, the National Educational Technology Standards (NETS). This covered integration of technology into learning and teaching, educational technology support standards, and standards for assessment of these skills. The total cost of the project was considerable, mostly spent on drafting and consultation meetings. However, there is no formal control mechanism to ensure State-run education systems adopt the output of such a Federally-funded project, and so dissemination of the NETS project has been patchy. Schools in Eugene near ISTE’s headquarters were unaware of it. On the other hand, the Ohio State objectives drew upon NETS to a high degree, and therefore the project has begun to be implemented though that state’s local government.

The Alberta Province of Canada has accepted the need to allow sufficient time for significant change to take place in schools. ICT has therefore been given a status unlike any other subject taught there, becoming enshrined in compulsory legislation. However, the regulations will not be activated until September 2000, giving schools over two years to prepare for the Interim Program of Studies.

Australia exhibits a wide range of stances towards the integration of information and communication technologies (ICTs) into classroom practice. As each State and Territory implements its own strategic plan for using computers to improve administration and library systems, and to enhance the IT infrastructure in school, there is a possibility of divergence of philosophy and practice. In some ways each state has a reputation for a different emphasis in classroom use: Tasmania for desk-top publishing, Queensland for databases, Western Australia for tutorial packages, and so on. There are however some recent national projects emanating from the Federal Department of Education, Training and Youth Affairs that appear to be investigating national benchmarks for ICT literacy and teacher professional development for the integration of ICTs into classroom practice.

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These glimpses into the processes of designing and implementing a national approach to the use of computers across the curriculum reflect the political contexts of the countries involved. However, it is instructive to quantify the time, energy and resources required to undertake such a process. Teachers have been acknowledged as crucial in the implementation stage, and basic computer skills training is only the tip of the iceberg in terms of their needs. These countries found they had to simultaneously address ICT infrastructure establishment, the training needs of teachers, and the issues of computer integration into every curriculum area, as part of a coherent and linked set of systemic changes.
<table>
<thead>
<tr>
<th>Locale</th>
<th>Title</th>
<th>Part of</th>
<th>date</th>
<th>Strand Organisers (arranged in columns of similar intent)</th>
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</thead>
<tbody>
<tr>
<td><strong>Tasmania and other states (unofficial)</strong></td>
<td>KITO - Key Information Technology Outcomes for students</td>
<td>1997 Operations and computer components</td>
<td></td>
<td>Publishing, Communicating, Researching, Problem Solving, Independent Learning</td>
</tr>
<tr>
<td><strong>Hong Kong</strong></td>
<td>Information Technology Learning Targets</td>
<td>1999 Skills</td>
<td></td>
<td>Knowledge, Developing ideas and making things happen, Attitudes</td>
</tr>
<tr>
<td><strong>England, U.K.</strong></td>
<td>Information and Communication Technology National Curriculum</td>
<td>2000 Reviewing, modifying and evaluating work as it progresses</td>
<td></td>
<td>Exchanging and sharing information, Finding things out, Social, ethical, and human issues</td>
</tr>
<tr>
<td><strong>United States of America</strong></td>
<td>National Educational Technology Standards for students</td>
<td>1998 Basic operations and concepts, Technology productivity tools</td>
<td></td>
<td>Technology communication tools, Technology research tools, Technology problem-solving and decision-making tools, Decision-making and problem solving</td>
</tr>
<tr>
<td><strong>Alberta, Canada</strong></td>
<td>Information and Communication technology (k-12) - an interim program of studies</td>
<td>1998 Foundational operations, knowledge and concepts, Processes for productivity</td>
<td></td>
<td>Communicating, Inquiring, Social, ethical, and human issues</td>
</tr>
<tr>
<td><strong>Australian Capital Territory, Australia</strong></td>
<td>Authoring including word processing and Web design: Presentation and visual display processes and tools</td>
<td>1999 Communication and collaboration, including e-mail and groupware, Information Access: Organisational processes and tools such as database packages</td>
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*Table 1. Strand indicators for ICT across the curriculum*
ICT frameworks in other regions and nations

Table 1 gives some of the strand organisers for cross-curriculum or subject-spanning frameworks for the integrated use of computers in learning. Each framework has been presented in terms of its major strand organisers. Strand organisers with similar intention have been grouped in the same column. This shows that, unsurprisingly, the frameworks have a high degree of uniformity. The differences appear to be of nomenclature, rather than substance.

<table>
<thead>
<tr>
<th>Commonalities:</th>
<th>Isolates:</th>
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<tr>
<td>Operations and computer components</td>
<td>Independent Learning</td>
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<td>Publishing</td>
<td>Control Technology</td>
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<td>Communicating</td>
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<td>Researching</td>
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<td>Problem Solving</td>
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<td>Social &amp; ethical issues</td>
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*Table 2. Common and unusual features of national ICT frameworks*

These strand organisers illustrate in broad detail the various approaches taken to guide students’ use of computers as an aid to learning. Only in the case of Utah do specific sets of mechanical skills get such a prominent place (Utah State Office of Education, 1994). The other sets of organisers show a remarkable degree of similarity, with similar phrases recurring. Problem solving, communication, researching, productivity/publishing are common themes. Basic operations and concepts, independent learning and social/ethical considerations can be found in some, but not in others (see Table 2).

Seeing these areas of agreement, it would be interesting to know the strategies employed to keep the associated curricula current. In the case of the England in the United Kingdom, the actual strategy has been a five-yearly review, though the author has not found any evidence that this was planned, nor is the revision cycle embedded in legislation.

Whilst these curriculum analyses have been presented for comparison purposes, there are parallel developments to provide the other factors necessary for radical change within the school system. Resource packages for equipment, networking, computer workstations, and Internet connectivity are highly complex logistical and quality assurance tasks. Teacher training, pre-service requirements and competency testing are vital components in the change, and need to be aligned to the curriculum framework. In very few policy documents has the issue of student-owned computing been raised, despite the common finding that this provides more hands-on experience than school machines.

The Three Phases

From the evidence accumulated during the data-gathering exercise, there appear to be three phases through which countries progress as computers become more prevalent in education.

**Phase 1**: where students in school first use computers, and information technology becomes a curriculum choice.

**Phase 2**: where information and communication technologies are used transparently to enhance learning opportunities in all conventional curriculum subject areas.

**Phase 3**: where the universal curriculum clearly includes topics of study that would not exist without information and communication technologies, and schooling for most students no longer fits the traditional face-to-face instructional model.

At the time of writing, most nations and states are struggling to achieve Phase 2 on as wide a front as possible. This is not an easy task, and requires enormous resources to achieve. For instance, the English approach has been to take a leap beyond training teachers in basic skills, and funding has been allocated to give each teacher approximately AU$1,400 worth of training over the period 2000-2001. This targeted training is subject-based, and should show teachers how to successfully integrate IT into their area of expertise. The critical elements to achieve success in this transformation have included the revision of the National Curriculum to include ICT (information and communication technology) in every subject area, as well as definitions of the ICT skills requirements of pre-service and in-service teachers.
Such huge projects as this are not isolated cases. Most Australian States have similar initiatives in progress, such as the Technology in Learning and Teaching (TILT) program in New South Wales. There is also some awareness of the implications of Phase 3 amongst departments of education, many of which are supporting the move of distance learning from written correspondence to the on-line environment. In Eugene, Oregon in the USA, students in regular schools had access to the CyberSchool (Layton, 1999), which offers subjects that are not available locally or were inaccessible due to timetabling restrictions. In Hong Kong, the Cyber Campus extends Internet access and email accounts to all school students. In Tasmania, the state distance learning organisation and colleges with distance education responsibilities are developing web-based courses using central government funding initiatives.

The development and take up of Internet-based educational opportunities has been swift, and points towards the start of Phase 3 in the above analysis. Although huge amounts of government funding are going into Phase 2, Phase 3 could well overtake it. This might be a good thing for students, offering them flexibility and uniformity in their educational opportunities.

Relative Success

It can be somewhat insidious to judge countries by extra-territorial standards. However, it can be justified when seeking to make comparisons about the reader’s local progress in a field and to elucidate guidance for national decision-making. A global assessment would be done on different terms to a local one, for it would compare nation with nation rather than analyse the best path given local circumstances. Infrastructure provision is a case in point, where economics to a large degree dictate the density and quality of ICT equipment that can be made available within schools.

Although economics can have a great deal of influence over the way in which countries have deployed ICT equipment in education, there are also significant policy factors at work. Estonia for example, forced by geography and economics, has instituted several projects that are Phase 3 in nature. The MIKSIKE web-site of worksheets for downloading into classrooms has been an excellent way to help teachers in isolated schools share teaching ideas.

Some criteria for assessing the progress of policy decisions would have to examine the success of ICT deployment in schools. Such criteria might include quantitative and qualitative comparisons of ICT infrastructure provision. Student learning using this equipment could be measured similarly. A more structural appraisal would examine the degree of integration between the three ingredients of ICT infrastructure, teacher professional development and curriculum structure. Another level of evaluation would gauge the degree to which the range of relevant policy initiatives had moved the country towards Phase 3.

Hong Kong appears to have a curriculum structure that is bringing Phase 1 experiences to all its school children. Whilst significant resources are being deployed to make ICT infrastructure available on a wide scale, the learning outcomes are mainly operational skills. England’s ICT projects firmly bind together student learning outcomes and teacher professional development, and the thrust is firmly at the Phase 2 level of integration into every subject area to enhance learning. Whilst a ‘back to basics’ policy of education is current in government, links to autonomous learning in Phase 3 are not outwardly encouraged.

Because of local state control in the USA, Federal initiatives are at the level of encouragement and facilitation. This has resulted in standards for students and teachers that are advisory rather than mandatory. Whilst the method has strength as these standards are adopted, the framework is designed around basic office productivity tools, making curriculum integration a local strategy decision. A similar situation pertains in Australia, with no national curriculum guidance and a variety of state projects.

The inclusion of Independent Learning as a computer-learning mode is becoming more widely accepted as an important problem. There could well be industrial issues for teachers in this. But also, there appear to be potential benefits for students (Web-based Education Commission, 2000)
Conclusion

Whilst the political, economic and other processes within each nation need to be fully understood before making specific comparisons, the material presented in this paper allow some generalisations to be made about the common approaches. Firstly, the preparation of a curriculum framework for the use of computers in schools has generally been a long and expensive process. Secondly, such a framework is only one of the strategies necessary for implementing real change in schools. The other main components are a clearly defined teacher training initiative that interlocks with the curriculum framework, well articulated links into all other curriculum areas, and deployment of suitable equipment. Thirdly, the focus is upon abilities very similar to the Key Competencies rather than mechanistic views emphasising vocational information technology skills. Fourthly, central governments have taken a more leading role in this area than in other subject areas, possibly because of the linkage of ICT with perceived international competitiveness and related economic growth. Finally, there is a clear understanding that any curriculum framework for ICT will require periodic revision in the light of technological changes. Moore's Law indicating 18-24 month quantum improvement cycles has proven remarkably accurate, and in some cases educators are forced to extend equipment life-cycles to make the cognitive load bearable for themselves, let alone their students.

Reflecting these generalisations into the Australian context, it is gratifying to see that the National Education Performance Monitoring Taskforce (NEPMT) established by the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) in April 1999 has commissioned a project team to develop a discussion paper on key performance measures. These measures will be used to monitor progress in the ICT knowledge and skills of Australian school students. If the stories from other countries are relevant to our situation, this could be the start of a long and expensive process to establish an agreed curriculum framework for ICT, which States and Territories will adapt to their local circumstances. It remains to be seen if the discussion paper is able to bend the focus from a vocational one to a wider context, and whether the other critical strategic elements will be linked to the unfolding process.

References


