ICT and the New Zealand secondary school curriculum

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Information and Communication Technology (ICT) does not have a strong presence in New Zealand secondary school settings. This paper examines the introduction of the new curriculum and ICT up to its development at the millenium. The current status of ICT in secondary schools is then outlined, and barriers and issues related to innovation adoption are discussed. Links are made with postmodern theory. A rationale for why schools should strive for integration of ICT is provided, and there are suggestions for how schools could achieve this.

Introduction:

ICT is defined in the technology curriculum as "… artefacts, systems and environment that enable the collection, structuring, manipulation, retrieval and communication of information in various forms" (Ministry of Education, 1995, p.12). This inclusive definition places emphasis on technology education. Hunt (1997, p.1) elucidates this by describing information as "… something that alters the way a person thinks, it is contained in messages that can be stored, retrieved and manipulated. Communication is the process of interchanging information". Information is data with meaning added to it. When it becomes incorporated into our personal understanding of the world it is transformed into knowledge. Wisdom develops when someone is able to apply that knowledge critically (Hunt, 1997).

This paper examines the place of Information and Communication Technology (ICT) in the curriculum of New Zealand secondary schools. Curriculum, in this paper, means the way education is put into practice: what happens in the classroom and what is taught and learned. "McCutcheon (1997, p.188) describes curriculum as the 'intended fare for schools', and teaching as 'its vehicle'. Teachers manage curriculum: it guides their work and informs their practice" (Carpenter, 2001, p.109).

The New Zealand Curriculum Framework (NZCF), (Ministry of Education, 1993) states that ICT emphasises the two essential skills of communication and information. It avoids discussion concerning ICT across the curriculum. Without guidelines on how to integrate ICT so that it is used to build on curriculum objectives and enthuse and engage students in meaningful learning, most educators resort to fitting it into existing structures.

There is a tension between the integration and insertion of ICT into curriculum. To help understand the reason for this tension, an historical perspective follows.

Historical Perspective:

1980s

Computers were first used in schools in the 1980s. In the absence of a coherent implementation policy, whether a school embraced the 'computer age' mostly depended on an enthusiastic staff member and funding. With little official leadership or financing, development was ad hoc; computer growth was haphazard and varied. From the mid-1980s various funding and professional development initiatives resulted in more schools 'plugging-in'. However many schools purchased inappropriate or incompatible hardware and software. By 1989 a Ministry of Education survey (PATT Project) concluded students had poor concepts of, but positive attitudes towards, new technology.

1990s

The 1990 Education Act signalled a new educational system, but gave no direction for teaching and learning with new technologies. Hodson (1990, p.10) referred to technology's potential to liberalise the curriculum. He notes "… a shift to a richer and more secure learning environment", and the computer's "… unsusceptibility to the middle class child's cultural capital…(plus its ability) to redistribute educational opportunity, bringing about another kind of 'educational revolution'". Bourdieu (1990) encouraged the development of guidelines for new technologies, saying the cultural capital of schools could conflict with that of homes, and possibly compromise student progress (cited in Harker, 1990). Notwithstanding this, by the end of the decade it is likely that computer use had amplified, rather than reduced socio-economic inequalities (Selwyn, 1999).

The absence of centralised co-ordination for professional development (PD) for ICT resulted in schools looking to pre-service providers for guidance. However, inadequate preparation of beginning teachers in the early 1990s was a strong theme world-wide (Persichitte, Caffarella & Tharp, 1990; Stetson & Bagwell, 1999; Strudler, McKinney & Jones, 1999). In New Zealand, the Sallis Report (1990, p.7) stressed concerns about "… the lack of teacher trainees' computer experiences". "The agents responsible for teachers' PD and support are Colleges of Education. They have the function of simultaneously reflecting good school practices (and)…providing leadership and innovation in a rapidly changing field" (Sallis, Ferguson, Frampton, Ham, Milne, McMahon, Parker & Ramsay, 1990, p.6):

> Student teachers need to be confident, competent users of computers with some understanding of how IT can facilitate learning experiences and develop thinking processes. Courses must continue to focus upon basic (computer) training until (students) enter college with a better background…(teacher educators must) also provide courses which focus on more educational issues (Sallis, et al, 1990, p.7-8).

It was during the 1990s that the NZCF was introduced.

New Zealand Curriculum Framework (1993)

The NZCF (Ministry of Education, 1993) made it mandatory for school students to participate in seven essential learning areas, practise eight sets of essential skills and consider values and attitudes. These elements are inter-related. The skills are developed in the context of the learning areas. The framework's objective was to ensure our education system met political, social, economic, technological and global challenges which were facing twenty-first century New Zealand, by establishing a set of teaching and learning principles which "… affirm and reflect New Zealand's identity" (p.1). The framework was

supported by a series of detailed national curriculum statements which were based around seven essential learning areas.

Technology - the use of knowledge, skills and physical resources to solve problems confronting human beings - is one of those seven essential learning areas. Technology-enhanced learning emphasises learning, not technology (Bracewell & Evans, 1998). “It is not (the use of) technology for its own sake. Technology is a ‘tool’ to promote learning” (Schooling, 2001, p.33). Brown, (1997, cited in ERO 1997, p.3) maintains that there are two separate domains of knowledge, and they should not be confused. “Technology education has its origin in the disciplines of technology, whereas educational technology has its roots in the area of educational psychology, that is, learning theory”.
There are seven technological areas and they are not mutually exclusive. As previously mentioned, one of these areas is ICT, which is not just computers, but includes audio and graphical communications, electronic networks and interactive multimedia. By 1998, the ICT Strategy Document was giving educators a “… more restrictive definition” of information technology, focusing on hardware and software (Ministry of Education, 1998a, p.2). This ‘technocentric’ definition is reflected in the explanation of communication technology which focuses on telecommunications equipment.

The current ‘technical’ definition of ICT, “… based on the main elements of hardware (and software), is conceptually flawed” (Brown, 2000, p.1). It does not provide a solid foundation upon which to build a national strategy for administration, learning and teaching (p.3):

> It is important to make a clear distinction between technology education – the development of students’ technological knowledge, capability, and understanding of the relationship between technology and society – and the use in education of learning technologies such as internet, CD-ROM, and faxes (Ministry of Education, 1998b p.7, cited in Brown, 2000, p.3).

In summary, ICT has different meanings in different contexts and educators see its place in the curriculum from differing perspectives. In learning about, and with ICT, students may participate in a wide range of activities from video-making, to newspaper production, developing skills and expertise in these technologies before using them in innovative ways to solve problems. ICT skills are cross-curricular and they can be integrated into all essential learning areas (Ministry of Education, 1998). Hunt, (1997, p.1) gives educators every justification for integration, saying "…modern technologies (can be) used to enhance teaching and learning….we can access, record and process digital text, sound, video and graphics; answer and send telephone messages…fax… television… edit videos and audio recordings and manipulate print" (Hunt, 1997, p.1).

Despite the good intentions of the curriculum, by the end of the century ICT was not an integral part of most New Zealand secondary school settings.

Pre-service teacher training and ICT

In order to prepare future teachers for the new curriculum, in the 1990s pre-service teacher educators began incorporating IT standards into their courses. By the middle of the 1990s, however, Information Technology Advisory Group (ITAG) was not convinced of the effectiveness of these programmes:

> All teachers must be well-trained in using IT to raise the quality of teaching …. Colleges of Education must take the lead … (and) use IT to help develop learning skills to extrapolate principles from facts and make deductions … not just for superficial 'trivial pursuits' on a computerised scale (Ministry of Economic Development, 1996).

The inability of schools to integrate ICT throughout the 1990s highlighted that initial teachers needed more than technical skills. Information skills and communication skills are two essential skills of each learning area. Using ICT in the classroom does not by itself meet curriculum objectives, its use needs to be an element of learning in the

classroom. The 1997 Green Paper on tertiary education concludes "…quality teachers can be seen as having …the ability to use (ICT) effectively as an aid to teaching" (MOE, 1997, p. 21). From the mid-1990s some government initiatives helped schools to establish an ICT culture. Examples include Te Kete Ipurangi Website (TKI); NetDay; ICT Clusters; Principals First; ICT Helpdesk. Hawk notes that some of these initiatives "… were compromised by poor planning, unclear, unrealistic expectations and inadequate funding" (Hawk, 1997, in Priestley, Higham & Sharp, 2000, p.67).

Until 1998, there was "… no compulsory requirement to train (student teachers) in IT" (Bracewell & Evans, 1998, p.13). "How have Colleges of Education managed to escape this technological age … lecturers should be demonstrating good practices … how to use IT across the curriculum to enhance learning … teachers should not be placed in classrooms unless they have attained and demonstrated a level of technological literacy…" (p.10-11). In 1999 the Education Review Office (ERO) joined the criticism concerning the inability of graduate teachers to use technology to facilitate learning (p.25).

By the late 1990s, when authors like Lawrence were describing the 'clickerati' as "…children of the 90s, they live and breathe technology…it isn't something exotic (but) part their everyday life" (1999, p. 11), few schools were integrating ICT. This was despite the fact that many offered a range of specialised ICT-type skill acquisition courses. This caused tension between those who advocated learning about ICT and those who believed in learning with ICT.

The 1998 ICT Strategy for Schools Document (Ministry of Education, 1998a) outlined Ministry aspirations for ICT and initiatives designed to meet those goals. It promised investment in equipment and Professional Development. Eighty-nine percent of secondary principals submitted an ICT plan, in return for funding. To the question "(W)hat is your perceived impact of ICT on the quality of curriculum delivery?", 53% said it was positive in 1998, rising to 56% in 1999. To the question "What is your perceived impact of ICT on the efficiency of curriculum delivery?", 43% in 1998, and

61% in 1999 answered positively. When asked the ways in which teachers had adopted ICT, 75% said teachers had developed an understanding of the process. 41% said their teachers appeared confident using new technologies, and 17% said teachers were using their new skills in other contexts. 1% said their teachers were using ICT creatively, in a cross-curricular manner (Ministry of Education, 1998a).

Thus, at the turn of the century, ICT was not integrated into the wider secondary school curriculum. However, at this time, 99% of schools had internet connection (Ministry of Education, 2001).

The Current Situation – 21st Century:

At a new millennium conference Australian Professor Dale Spender encouraged New Zealand educators "… get cyber-savvy - prepare today's students for the knowledge economy – there's no place for computer-incompetent teachers in the 'Information Age'" (Evening Standard, 2000, cited in Brown, 2000, p.5). The Education Review Office (2000) reported that implementation of ICT was in its early stages, with low-level teacher skill and confidence, many infrastructural issues unsolved, and little evidence of enhanced learning. Only 28% of secondary schools were networked and had quality hardware and software, ongoing Professional Development, and reflected an established ICT culture with a strong pedagogical foundation. Decile rating was not a factor in distribution.

The recently published 2002-2004 ICT strategy update (Ministry of Education, 2002) builds on other initiatives, focussing on narrowing the gaps previously described and on teaching and learning for a new digital generation. The aims are to extend and deepen educational experiences and to help develop an innovative, thriving society, rather than emphasise only the technical skills (p.6). Attention has moved to management and administration processes, developing action plans to meet goals and an appropriate ICT infrastructure, and addressing the 'digital divide'. While more teachers have basic skills in using new technologies, most still do not achieve (or even try for) meaningful integration in their subject areas.

Issues and barriers related to innovation adoption:

To achieve these twenty-first century goals, schools need to address a range of issues. Lack of teachers' technical skills can be overcome by lending equipment or subsidising its purchase, and by providing PD and release hours. Schools need to ensure teachers have basic trouble-shooting skills, and they must provide technical support staff. Baker & Hansen (2002) argue that basic skills are an essential foundation to more complex ICT based learning, and that PD which emphasises higher order cognitive skills will yield better teacher skills than simple training.

"For transformational changes to occur, beliefs about teaching and learning must change together … single course offerings are not conducive to the transfer of skills and knowledge to realistic contexts" (Brown, 2000, p.9). Skill acquisition does not necessarily lead to critical and creative thinking, or to improved pedagogy. ICT use must be pedagogically sound, and its use must be supported by the school (Berenfield & Schrum, 1997, in Fisher, 2000). Using ICT skills encompasses learning and teaching processes, and "… clearly signals an interest in the educative process as distinct from technology per se" (Brown, 2000, p.3). Good teaching is a cognitive process – performance is not measured by action alone – it is not a set of ICT skills in isolation from a capacity to think (Hilty & Gitlin, 1996, in Brown, 2000).

Organisational and structural provisions within schools can both support and obstruct ICT implementation. Organisational constraints define boundaries within which teachers develop their ideas or change their attitudes about using computers in teaching. Timetables, computer access and location, quality and reliability of multimedia, security and safety issues - all need to be user friendly. This signals a need to "…build a human infrastructure as well as hardware and network infrastructures" (Morrison, Lowther, & DeMeuller, 1999). Computerised administration systems (the paperless environment), integration of all class and management records, adequate funding and strong leadership are all components of a wired schools culture.

Attitudinal barriers demonstrated by comments such as ‘why change? stick with what you know rather than risk looking incompetent’ , ‘why invest the extra time and energy needed to incorporate ICT into my practice?’, often demonstrate a lack of confidence. These comments indicate teacher self-image and views about technology. Lack of commitment from school leadership to support innovation, or believing that implementation is a top-down approach, also disempowers teachers.

Strategy-based approaches can enhance learning. “Literature on computers and constructivist reforms describe a variety of activities that are permitted with computers that are not feasible otherwise” (Wilson, Teslow, Cyr & Hamilton, 1994, cited in Becker & Ravitz, 1999, p.358). These authors discuss strategies – collaboration, project work, hands-on activities, action research – which could be used in student-centred lessons. Teachers need to develop methods appropriate for skill acquisition: modelling, coaching, scaffolding, articulation, reflection and exploration. Over time, “as the learners’ skills advance, the teacher’s role evolves from technical adviser and demonstrator, to manager and facilitator, then on to consultant and co-learner” (Hill, 2000, p.15).

The real issue is not whether ICT enhances learning but whether it provides a context for creating better learning conditions (Brown & Ryba, 1996). Capper (1999) maintains that those who take risks to improve student learning must have no doubt they are highly valued. Leaders must articulate a personal belief in the value of ICT in learning, demonstrate vision, offer role models and make clear the need for innovation (Kwok-Wing Lai, 1999). They must provide practical benefits and encourage collaboration and reflection. There must be on-going collegial support for those who ‘walk the talk’, and incentives for risk-takers who trial innovative practices. Adoption depends on a teacher's teaching and learning philosophy, and personal perception of the value of technology. Classroom practice involving ICT needs to be seamlessly linked to the curriculum.
The world is shrinking, and a new culture is immersing children. This new culture is changing the way we teach and learn, the move is beyond technical skills towards new

social, thinking and metacognitive skills (Roder, 2001, p.8). “Modern conveniences have become so transparent in our lives that their impact is only apparent in their absence” (Lawrence, 1999, p.11). Gray (1999) suggests teachers should attempt to establish a culture where the use of ICT enhances not only the curriculum but also the core values and beliefs held by the school. This author maintains that depth of interaction with data is more important than breadth. Brown & Vossler (2000, p.51) advocate that we “… build a culture that promotes a clear philosophy of education and life-long commitment to innovative teaching with technology”, while Persichitte et al (1999, p.230) warn that “… there is no indication that the classroom teacher’s role will not continue to mutate as both educational products and process tools evolve”. As ‘mind tools’, computers arguably provide the greatest potential for meaningful integration (Grabe & Grabe, 1998).
Students must acquire information literacy skills. The ‘3Rs’ are no longer enough, and substantial evidence suggests information literate students who can think, reason, read, discriminate, select, reject, sift, analyse and interpret information make far better use of ICT than those who cannot (Dutton, 1998). Information literacy is the ability to define and plan the task, access and evaluate resources, extract information, organise, present and evaluate.

Finding appropriate information and using it effectively is of greater value than remembering facts (Hunt, 1997). It is having learned how to learn. In a society bombarded with information, students must learn to discriminate, select, process, and create meaning - or knowledge.

Teacher education

The ICT competence level of student teachers increases each year, yet pre-service teacher educators continue to graduate some students who cannot incorporate ICT into their classroom practice. All providers claim to include technology education modules, implicitly implying ICT is part of technology (Brown, 1999). Unless integration is consistently modelled, students receive a message of ‘do as I say’, not ‘do as I do’. Teacher educators need to "… develop instructional environments that not only expect …

(ICT) integration by our future teachers, but which model effective uses as we prepare (them) …" (Persichitte et al,1999, p.231). The one-off Maths visit to the computer lab to explore databases gives the message that the computer is a 'tool' or 'add-on' – it is not integration. Occasional use of multimedia in History, is likely to be an add-on rather than being 'value-added'.

Brown (2000) identifies three responses of teacher educators. These are the standards response, the critical response and the combined response.

Standards response

The standards response (Scheffler & Logan, 1998; Lum, 1999) with its performance-based standards or competencies, follows a mechanistic model of teaching (Lum, 1999, p.6). Basic ICT standards have value but they belittle the complexity of pre-service teacher education, being at odds with the goal of meaningful curriculum integration. Standards do not cater for the all-round development of teachers or address fundamental beliefs about teaching and learning. Is what you define as standards what you achieve? A narrow standards approach merely addresses the current wave of technology.

Critical response

The critical response (Hilty & Gitlin 1996, cited in Brown, 2000) values beginning teachers with a well-developed philosophy of teaching based on a critical understanding of educational theory, research and practice. "Good teachers know their subject well" (Snook, 2000, in Brown, 2000, p.8). ICT is only one type of knowledge. Contextual knowledge of education itself is mostly missing from the standards response. "Without a critical knowledge of educational theory and research, and a philosophical framework for applying this in one's teaching, critical reflection, especially in ICT, is highly problematic" (p.9). Emphasis is needed on the learning process – learning with ICT is "… not an end in itself, but rather a means of helping students to become more effective learners across the curriculum" (p.3).

Combined response

The third option, the combined response, distinguishes between basic skills and the use of new educational technologies for curriculum and pedagogical purposes. This provides a useful framework for conceptualising teacher education. Teachers are expected to integrate ICT daily, demonstrating sound understanding of good teaching rather than just good ICT teaching. Pre-service teachers do not experience ICT in authentic and thematic curriculum activities, which leads to a problem of transfer. This response fails to address personal beliefs and the institutional culture in which technology is embedded. Standards should address teaching competence generally from a critical model of teacher education, not ICT per se. "ICT is not a stand-alone subject and beginning teachers must be critically prepared to integrate (ICT) … in all learning areas" (Brown, 2000, p.1). There is great disparity in the technological preparation of pre-service teachers.

The roles of the teacher and learner are changing. ICT, if used to support new models of teaching and learning, can help transform schools (O'Neil, 1995, in Ryba, et al, 2000). Changing a teaching philosophy is difficult, but critical to developing innovative practice. ICT is more aligned with constructivist learning theory, since it encourages and enables peer discussion and shared development using interactive, collaborative methods. Content focuses on relationships, inquiry and processes rather than memorisation, facts and goals. Technology supports active learning, and becomes a tool with which the students may construct knowledge. The teacher is a coach and facilitator rather than a transmitter of knowledge. Bernstein (1971) predicted the need for a flexible, adaptable, multi-skilled person – a life-long learner, able to cope with shifts in the social order. These are pre-requisites for twenty-first century living.

This does not change the approach to teaching but it enhances the experience. Students integrate new ideas into their prior knowledge to make sense or meaning. Dias (1999) suggests that by working in learning communities, and contributing to the group's goals, students maximise each other's learning. Fosnot (1996) and Cole (1996) maintain that the constructivist model of learning emphasises that new understanding results when a

learner acquires and organises new information; new learning shapes, and is shaped, by prior schemata. McFarlane (1997, p.141) believes that effective teachers know "… how and when to intervene to build and dismantle the scaffolds which help children scale heights which they cannot scale alone". Bruner (1986, p.27) emphasises "… discovery and invention (and) the importance of negotiation and sharing".

A postmodern perspective:

Modern thought dominated last century. In line with industrialised society, schools adopted assembly line models (Doll, 1993, Bobbit, 1918). Tyler's rationale found expression in the curriculum, allowing transmission but not transformation of knowledge. The major outcome was social reproduction (McKinnon, Nolan & McFadden, 1992).

As the new paradigm of postmodernism emerged new technologies were entering schools. Curriculum concepts based on postmodernism needed a new rationale to replace Tyler's. The '3 Rs' is suited to an industrialised society. The '4 Rs' of richness, recursion, relations and rigour suit the present. Postmodernism sends a message of self-regulation with its dynamic and transformative interaction, a point Dewey, Bruner and Piaget made. Through exploration, students and teachers clear the land, transforming both it and themselves. Curriculum becomes the process, learning and understanding come from dialogue and reflection (Doll, 1993). Postmodernism sees curriculum as rich, open experiences "… a complex mosaic ever shifting its centre of attraction as we shift ourselves" (Doll, 1993, p.38). It is spontaneous, with an acceptance that students will construct their own learning.

The implications of a postmodern perspective in education and curriculum are tremendous. A new sense of educational order is emerging with new teacher-student relationships, more group interaction, and a more equitable system. Authority shifts, "… changing the pattern from 'the course run' to the 'course runner running' " (Doll, 1993, p.4). There is a move from mass to personalised teaching, from memorising to problem-solving, text to multimedia, behaviourist learning theory to cognitive learning theory, norm to criterion referenced, traditional didactic pedagogy to developing collaborative

understanding (Doll, 1993). A constructivist curriculum can emerge through the action and interaction of the participants. Theory can be grounded and developed from practice.

ICT and postmodernism

ICT complements the postmodern perspective. In post-industrial postmodern education ICT should reflect current practice, rather than transforming the process of teaching and learning. The principles of postmodernism are reflected by the self-organisational nature of global networks and the constructive approaches used. Bigum (1993) suggests its ideology will subvert the traditional teaching approach.

Apple (1987) however, maintains that the computer ethos (replacing the teacher's ethos) is dangerous for society, and believes there will be a negative effect on society if the computer ethos 'takes over'. In contrast Toffler (1990) maintains power is based on money, muscle and mind, and that ICT is breaking down large units through easier access to knowledge. There needs to be a paradigm shift, from placing importance on memorising or regurgitating facts to learning to access and process information. Pedagogy requires self-regulated, intrinsically motivated students who control their own learning, and teachers who use new strategies such as formative assessment.

Postmodernism addresses many of the issues and barriers put forward in this essay, yet Middleton's comment that "ICT will likely as not become the cross-curriculum fashion of the 2000s" has not yet been validated (Middleton, 1999, p.2). Apart from a few 'hi-tech' teachers and classrooms, the application of ICT in secondary schools is disappointing, with little evidence of meaningful curriculum integration (O'Neil, 1995, in Ryba, et al, 2000).

Where to from here?

We cannot graft ICT on to out-dated structures and approaches to learning. Innovations must be grounded within a contemporary (postmodern) understanding of the teaching and learning process (Brown & Ryba, 1996). We need constructivist-oriented teachers using tool software and ICT for their students' construction of understanding (Dexter,

Anderson, & Becker, 1999). Because the integration of ICT is becoming an increasingly critical issue (Bracewell & Evans, 1998) schools need help in identifying and implementing quality models. This help may counteract Middleton's prophecy that the overall thrust given to ICT by the secondary curriculum will be neither coherent in its expression, nor effective in its impact because curriculum change is a twenty-year process (1999).

Teachers have to learn to think like good teachers. It is a cognitive process – performance is not measured by action. Teaching is an intellectual activity – a creative art, not just a learned profession (Hilty & Gitlin, 1996, in Brown, 2000). This talent cannot be standardised.

Schools must reconstruct ICT with educational rather than technological aims, and shift educational policy to an integrated and societally focussed role. Teachers must create a collaborative online environment, generate a vision, and understand the origins and intent of theories that inform their work. The pursuit of principles of learning rather than technological tools will attend to context as well as process (Hansen, 2002). It is always difficult to create new practices; in an inhospitable environment it can be impossible. There are a multitude of policies and attitudes about the curriculum. Like a jigsaw puzzle, changing a piece in the centre is futile without changing the surrounding pieces. Significant changes in ICT require significant changes in the entire system.

ICT should be a planned component which supports staff and student research and innovation. Successful, rich, exciting environments duplicate excellence and motivate students. Interactive software encourages creativity and innovation. Learning involves social participation (Young, 1998). ICT can be " … integrated in a manner that provides a rich context for students' understanding of pertinent concepts, themes and processes" (Moersch, 1995, p.42, in Lockard, 1997, p.365). Teaching ICT across the curriculum allows a meeting of "… pedagogical thought and technological breakthroughs that fit like a hand in a glove" (Thornburg, 1991, p.7).

The effective wired practitioner ensnares technology to service and support learning, as opposed to submitting to technological determinism whereby technology shapes teaching. All teachers need to develop basic ICT skills, information literacy skills and the language of ICT in context. They must foster equitable, ethical and legal use of these technologies, keep abreast of research, and understand how ICT can enhance personal growth and production. A shift in educational paradigms is crucial to implementation. Schools often voluntarily adopt ICT innovations to promote their image as up-to-date and efficient, and because it is bureaucratically safe they can add resources without behavioural change.

Integration goes through several stages. At the entry stage there is trepidation and excitement. The adoption stage is mostly drill and practice. Once technical skills have been acquired the adaptation stage is reached. ICT begins to permeate practice. When ICT is understood and used seamlessly, the appropriation stage is reached. Implementation is characterised by 'pockets' of innovative practice. When the innovation becomes a natural part of 'the way we do things around here' (culture), it has been institutionalised and becomes an integral component of classroom practice. This is the invention stage – Bloom's synthesis and beyond. At this point infrastructure expands to meet increasing user demands (Fullan, 1999).

Continuing PD must be informed and underpinned by educational principles, in contrast to competency training (Baker & Hansen, 2002).

Papert (1987) cautions that integrating technology entails a systematic change of processes, practices, policies, power and philosophy. ICT started as a presentation tool, moved to a productivity tool and must now move to a thinking tool. "Technology is integrated when it is used in a seamless manner to support and extend curriculum objectives and to engage students in meaningful learning" (Dias, 1999, p.12). When multimedia use blends into the 'mundane' of school life, integration is complete.

Conclusion

Apart from isolated cases, ICT has not yet been incorporated into the New Zealand secondary school curriculum. The NZCF does not provided the structures and guidelines necessary for educators to integrate these new educational technologies across all learning areas and too many teachers try to fit ICT into old structures.

"To be truly effective, technology should be integrated, not inserted, into the education setting" (Barto, 1996, in Selwyn, N., 1999, p.80).

REFERENCES

Apple, M. (1987). *The new technology: Part of the solution or part of the problem.* Canberra: Curriculum Development Centre.

Baker, P. & Hansen, J.J. (2002). *The wired practitioner – making sense of ICCT for teaching and (practitioner) research*. UNITEC Seminar Series 2002, Auckland: UNITEC.

Becker, H.J. & Ravitz, J. (1999). The influence of computer and internet use on teachers pedagogical practices and perceptions. *Journal of Research on Computing in Education, 31* (4), 356-383.

Bernstein, B. (1971). On classification and the framing of educational knowledge. In M.F.D. Young (Ed), *Knowledge and control*. London: Collier-MacMillan.

Bigum, C. (1993). Curriculum and the new mythinformation technologies. In *Curriculum, technology & textual practice.* Geelong, Vic: Deakin University Press.

Bobbit, J. (1918). *The curriculum.* Boston:Houghton Mifflin.

Bracewell, M. & Evans, M. (1998). Where we are and where the Ministry of Education is taking us in information technology. *Computers in New Zealand Schools, 10(*2), 9-15.

Brown, M.E. (1998). The Use of Computers in New Zealand schools: A critical review. *Computers in New Zealand Schools, 10*(3), 3-9.

Brown, M.E. & Vossler, K. (2000).Teacher preparation for the 21st Century: What should we be teaching beginning teachers? *Computers in New Zealand Schools, 12*(3), 47-53. Nov.

Brown, M. & Ryba, K. (1996). Superhighway teachers: The effective use of the internet in education. *New Zealand Principal,* Vol. 11, No. 4. Nov.

Brown, M. (1999). *A Ministry perspective. Pathways to technological literacy.* A paper presented at the Telecom Technology Education NZ Conference. Kings College, Auckland. April.

Bruner, J. (1986). *Actual minds, possible worlds.* Cambridge, MA:Harvard University Press.

Capper, P. (1991). Curriculum 1991. In H. Manson (Ed.). *New Zealand Annual Review of Education, 1991*. Wellington: Victoria University of Wellington.

Carpenter, V.M. (2001). Curriculum and the (re)production of education. In V. Carpenter, H. Dixon, E.Rata, & C. Rawlinson (Eds). *Theory in practice for educators.* Palmerston North: Dunmore.

Cole, M. (1996). *Cultural psychology*. Cambridge, MA: The Belknap Press of Harvard University Press.

Dexter, S.L., Anderson, R.E. & Baker, H.J. (1999). Teachers views of computers as catalysts for changes in their teaching practice. *Journal of Research on Computing in Education, 31*(3). 211-229.

Dias, L.B. (1999). Integrating technology: some things you should know. *Learning and Leading with Technology, 2*, (3), 10-21.

Doll, W.E. Jr. (1993). *A post-modern perspective on curriculum.* New York: Teachers College Press.

Doyle, C. (1995). Information literacy in a literate society: A concept for the information age. In Henri, J. & Bonanno, K. 1999. *The Information literate school community: Best practice.* Centre for Information Studies, NSW, Australia: Charles Sturt University Press.

Dutton, D. (1998). Dennis Dutton's sceptical look at computer-enhanced learning. *Good Teacher,* May.

Education Review Office. (1999). *Pre-employment training for school teachers.* Wellington: ERO.

Education Review Office. (Oct. 1997). *The Use of Information Technology in Schools.* Retrieved from; http://www.ero.govt.nz 2002.

Education Review Office. (2000). *The implementation of information and communications technologies (ICT) in New Zealand Schools.* Wellington: Learning Media.

Fisher, D. (2000). History Teaching with ICT: The 21st Century's 'gift of Prometheus'? in *ACE Papers* Issue 7, Auckland: ACE Research Services. 46-58. July.

Fosnot, C. T. (1996). *Constructivism, theory, perspectives, and practice*. NY:Teachers College Press.

Fullan, M.G. (1992). *Successful school improvement.* Bristol, PA: Open University Press.

Grabe, M. & Grabe, C. (1998). *Integrating technology for meaningful learning.* (2nd Ed.). Boston: Houghton Mifflin.

Gray, D. (1999). Developing a learning culture. *Computers in New Zealand Schools, 11*(2)30.

Harker, R. (1990). Schooling and cultural reproduction. (Eds. J. Codd, R. Harker, R.Nash), p.39. In *Political issues in New Zealand education.* Palmerston North: Dunmore.

Hill, R. (2000). Managing a multimedia classroom. *Computers in New Zealand Schools, 12*(2), 13.

Hodson, D. (1990). From computer studies to information technology: An emerging sense of direction for computer-based education. *Computers in New Zealand Schools.* 2(3), 14-19.

Hunt, A.N. (2000). Information technology in pre-service teacher education within a New Zealand college of education. *Unpublished M.Ed. Thesis*. Palmerston North: Massey University.

Hunt, T. (1997). Defining ICT and its role in education. Centre for Technology. 904.501. *Information and Communication Technology Set Readings 2000.* [unpublished].

Kwok-Wing Lai (1999). (Ed) *Net Working – Teaching, learning and professional development with the internet.* University of Otago Press.

Lawrence, V. (1999). Becoming digitally literate. *Education Today, 2* (T.2), 11-12.

Lockard, J., Abrams, P. & Many, W. (1997). *Microcomputers for twenty-first century educators.* (4th Ed.) NY: Longman.

Lum, G. (1999). Where's the competence in competence-based education & training? *Journal of Philosophy of Education, 33* (3), 403-418.

Mawson, B. (1998). Technology: flogging a dead horse or beating the odds. In ACE Papers, Issue 2, 38-50. Auckland: ACE Research Services.

McFarlane, M. (1997). (Ed.). *Information and technology and authentic learning: Realising the potential of computers in the primary classroom.* London: Routledge.

McKinnon, D. H., Nolan, D.J.P. & McFadden, M. (1992). *Changing education: Towards productive and collaborative practice.* Australian Federal Government.

Middleton, S. (1999). Between a rock and shifting sands: Issues of curriculum implementation in secondary schools. A paper presented at the *TENZ Conference*, Kings College, April, Auckland.

Ministry of Economic Development. (1996). ITAG. *Impact 2001: How information technology will change New Zealand.* Retrieved from http://www.med.govt.nz/pbt/index.html

Ministry of Economic Development. (2000). ITAG. *ICT in schools 1999* Retrieved 2002: http://www.med.govt.nz

Ministry of Economic Development. (1999). *Information technology education – A briefing to the Minister of Information Technology. Retrieved 2002* http://www.med.govt.nz/pbt/index.html

Ministry of Education. (1989). *PATT Project*. Wellington: Government Printer.

Ministry of Education. (1993). *The New Zealand Curriculum Framework.* Wellington: Learning Media.

Ministry of Education. (1995). *Technology in the New Zealand Curriculum.* Wellington: Learning Media.

Ministry of Education. (1997), *Tertiary education in New Zealand – Policy directions for the 21st century – Green Paper*. Wellington: MOE.

Ministry of Education. (1998a). *Interactive education – An information and communication technologies strategy for schools*. Retrieved 2001 from www.minedu.govt.nz/document_page.cfm?id=5923

Ministry of Education. (1998b). *Implementing technology in New Zealand schools, Years 1-8.* Wellington: Learning Media.

Ministry of Education. (2002). *Digital horizons – Learning through ICT. A strategy for schools, 2002-2004*. Wellington: Learning Media.

Ministry of Information Technology. (1999). *Information technology and education.* Wellington: Learning Media

Morrison, G. R., Lowther, D.L. & Demeuller, L. (1999). *Integrating computer technology into the classroom.* Upper Saddle River, NJ:Merrill.

Moursund, D. & Bielefeldt, T. (1999). *Will new teachers be prepared to teach in a digital age? A national survey on information technology in teacher education.* Milken Exchange on Education Technology, USA: ISTE.

Papert, S. (1987). Computer criticism vs. technocentric thinking. *Educational Researcher, 16* (1), 22-30.

Pellegrino, J. (1998). Learning technologies teacher capabilities – A framework for professional development. Research Information for Teachers. NZCER, SET Two, in *Network. Oamaru: CETA.*

Persichitte, K. Caffarella, E. & Tharp, D. (1999). Technology integration in teacher preparation: A qualitative research study. *Journal of Technology and Teacher Education, 7*(3), 219-233.

Priestley, M., Higham, J. & Sharp, P. (2000). Local innovation or government initiative? Curriculum specialisation in New Zealand's education quasi-Market. *New Zealand Journal of Educational Studies 35*: 61-77.

Roder, J. (2001). Beyond 'tool skills' in an ICT learning culture. *Education Today, Term 2*(3) 8.

Ryba, K. & Anderson, D. (1993). *Learning with computers: Effective teaching strategies.* Eugene, R: International Society for Technology Education.

Ryba, K. & Brown, M. (2000). How proficient IT teachers integrate computers into the curriculum. *Journal of Computing in Teacher Education. 16* (4). 1-11.

Sallis, P., Ferguson, D., Frampton, A., Ham, V., Milne, A., McMahon, T., Parker, L. & N., Ramsay, V. (1990). *Report of the Consultative Committee on Information Technology in the school curriculum.* Wellington: MOE.

Scheffler, F. & Logan, J. (1998). Computer technology in schools: what teachers should know and be able to do. *Journal of Research on Computing in Education, 31*(3). 305-326.

Schooling, H. (2001). Measuring the curriculum of technology – enhanced classroom delivery. University of Sydney, IT Department. *Network*. Oamaru: NZCETA.

Selwyn, N. (1999). Why the computer is not dominating schools: a failure of policy or a failure of practice? *Cambridge Journal of Education (29).* (1), 77-91.

Strudler, N., McKinney, M. & Jones, P. (1999). First-year teachers' use of technology: Preparation, expectations & realities. *Journal of Technology and Teacher Education, 7*(2), 115-129.

Thornburg, D. (1991). *Education, technology and paradigms of change for the 21st century* USA: Starsong Publications,7, 43-46.

Toffler, A. (1990). *Powershift: Knowledge, wealth and violence at the edge of the 21stCentury.* New York: Bantam Books.

Tyler, R. (1949). *Basic principles of curriculum and instruction.* Chicago: The University of Chicago Press.

Webb, L. (1999). Investigating science. In A. McFarlane (Ed.). *Information technology and authentic learning: Realising the potential of computers in the primary classroom.* London: Routledge.

Young, M.F.D. (1998). *The curriculum of the future: From the new sociology of education to a critical theory of learning.*(1st Ed.). London: Falmer Press.