Sabbatical Report by Craig Sharp, Principal, North Street School, Feilding.

Question:

Can ICT raise attainment levels, increase engagement and lead to greater participation?
Do these technologies improve teaching and learning outcomes?

Background:

In 2010 the Ministry of Education released a DVD *"21st Century Learner: A glimpse of the Future"*. This DVD showed the likely impact of information communication technologies (ICT) on classrooms over the next few years. The DVD outlined the ways in which schools could use, and are using, ICT in innovative ways to improve teaching and learning.

The DVD is structured around what learning might look like when schools are part of communication and learning networks: It provides examples in the four areas of; Connectivity, Access to information, Relationships with the community and Capability building. The information and direction in this DVD supports the Ministry's own e-Learning action plan published in 2006.

At North Street School our own action plan links to this and to the curriculum goals of developing Confident, Connected, Actively Involved, Life long learners.

On page 36 of the NZC it says:

"Schools should explore not only how ICT can supplement traditional ways of teaching but also how it can open up new and different ways of teaching."

That statement really sums up, in one line, the intent of my sabbatical. How has the availability and use of ICT, impacted upon pedagogy, to lift achievement in schools, using *new* and *different* ways of teaching?

Hypothesis:

I am concerned that in many schools the massive ICT spend has resulted in students doing the same work with new tools. Instead of cutting and pasting from a magazine students are now cutting and pasting from the Internet. Instead of spending hours on borders and title pages, students are publishing on computers using a dozen colours and fonts.

The amount of money being spent is difficult to justify if there is no change in the quality of learning for students or the quality of teaching for teachers.

The aim of the NZC was to produce confident, connected, engaged, life long learners. ICT definitely has a role to play in this but only if schools change not just what they teach, but how they teach it.

During my sabbatical I undertook intensive professional reading and visits to numerous schools to find evidence of change of practice and impact on student outcomes that have been forecast and anticipated as a result of ICT's.

The professional reading, analysis and reflection was undertaken to make sense of what is already understood and to draw parallels where possible between current NZ and overseas studies relating to ICT's in schools.

Much of the reading was around the initial studies from NSW on laptop connectivity and student outcomes, and the many UK studies on IWB's and their impact on learning. I then looked at the NZ studies on best practice and effective teaching and learning, to compare and contrast results and to look for patterns.

School visits were to many schools in New Zealand who had claimed "digital class", "Connected" or "21st Century learners" in their charter. Out of respect to those schools and their communities, and as a measure of my appreciation for their generosity in giving time and information, I have not spoken about individual schools but generalized my findings.

Research:

It has long been recognised that the study of pedagogy is crucial to understanding the potential role of ICT in teaching and learning and the ways in which teachers might appropriate these new technologies. For many years, however, research exploring the use of ICT by students in learning across the curriculum, has found only limited adoption of new technology for purposes *other* than either learning *about* computers, or learning about software for computers.

The massive resourcing of interactive whiteboards (IWBs) into classrooms in the UK has altered this situation, and has led to a parallel upsurge of interest in research into the effect of IWBs in classrooms on the part of both policymakers and researchers, with policymakers interested in measuring the expected gains in attainment, and researchers more interested in relating and illuminating how IWBs are used to support learning.

Similar studies are already beginning in New South Wales where Laptops, wireless connectivity and a wealth of teaching resources created by the Education Department, were to be made available to all Year 9 to 12 students in NSW public schools by 2012.

This display of generosity by the NSW government was based on evidence presented to it that showed, that where technology is used effectively in schools, the results are inspiring. Improved grades and retention rates, resulting in greater participation by students and increased effectiveness by teachers.

This is in contrast to the surprise conclusion of a two-year study covering six LEAs carried out by Newcastle University and published by the UK government's ICT agency, Becta, earlier this year. It concluded that the millions of pounds that have been spent on providing schools with interactive whiteboards, in the belief that they could act as powerful aids to raising achievement, are having no discernible impact on children's test scores.

Two completely contrasting verdicts, so, what is the truth? Can ICT raise attainment levels, increase engagement and lead to greater participation?

Do these technologies improve teaching and learning outcomes? As Jane Gilbert states in her paper '*Creating digital age learners through school ICT projects: What can the Tech Angels project teach us?*' Educational issues are invariably highly contested and politicised, and the solutions to educational problems are inevitably compromises that bring together ideas from many different sources.

Unfortunately, there is little research with evidence of impact on pupil attainment. Observations in schools consistently show that ICT is typically used for drill and practice and typing up of a 'Best Copy' (Chalkey and Nicholas 1997: Mumtaz and Hammond 2002). This may help to explain the generally low impact of ICT on attainment reported in papers like the 'ImpaCT 2 study undertaken in the UK. (Harrison et al 2002).

It is generally believed that ICTs can empower teachers and learners, promote change and foster the development of '21st century skills, but as stated earlier, data to support these beliefs is, at this stage, at best, limited.

There is widespread belief that ICTs can and will empower teachers and learners, transforming teaching and learning processes from being highly teacher-dominated to student-centered, and that this transformation will result in increased learning gains for students, creating and allowing for opportunities for learners to develop their creativity, problem-solving abilities, informational reasoning skills, communication skills, and other higher-order thinking skills. I also believe there is a real desire from the teachers I spoke with that this type of student centred paradigm be realised, however, there is currently very limited, unequivocally compelling data to support widespread evidence of this change.

In addition, the curriculum (NZC), National Standards and assessment are seen by many as acting as a brake on any process of change, by influencing and prioritising which skills are taught and how, because of the way these are required to be assessed. (Torrence, 1997)

Why bother?

Many argue that with our current system performing well in PISA and similar tests and given our relatively modest spend on education compared to those countries around us on the PISA table, we should be satisfied with our current system. However the governments mission to raise achievement is a noble one and we currently work in a climate where the focus is on accelerated achievement and improved outcomes.

This fitted nicely with my focus and only made me more curious about whether ICT had a role in improving what we do.

One argument for ICT use is around the efficiencies that ICTs can bring around planning, data collection and analysis, publishing etc. Using this argument, it makes good sense to use ICT in schools, because it makes these types of administration tasks so much easier, faster and more cost effective.

This argument is the least radical of the arguments for ICT in schools, in that it entails minimal changes to existing school practices. It does not challenge in any way current pedagogical practices or any of the assumptions that may underlie them.

Teachers are expert at creating tools to transform practices and knowledge. ICTs are now an essential part of this creative production. Knowing how to use these tools to transform learning in schools is however, not uniform or straight forward. This is because new ICT tools often challenge an existing practice of teaching or learning and threaten current school practice.

Across the most advanced schools in OECD countries, ICTs are generally not considered central to the teaching and learning process. Many of the ICT in education initiatives seek to place ICTs as central to teaching and learning and this appears to be a common and enduring problem across developed education systems: putting the technology before the education.

One of the enduring difficulties of technology use in education for teachers is that educational planners and technology advocates think of the technology first and then investigate the actual educational applications of this technology only later.

The connection between policy and pedagogical use of ICT in Scandinavian countries that top PISA results, Finland, Norway and Denmark, is made explicit through policy. In regard to policy concerning school and curriculum development, all three countries have made profound efforts to integrate the pedagogical use of ICT into the formal framework for their school systems (Arvedsen 2008; Helland 2008; Kankaanranta 2009).

In my observations this "technology before pedagogy" was, unfortunately, obvious in many schools. Interactive whiteboards have, in many schools, brought the teacher back to the front of the class as the "sage on the stage" undoing 15 years of roving and coaching.

In many digital classrooms students were at individual desks, laptops in front of them, facing the white board. No obvious connection or collaboration just a trade off of books and reference material for laptop and the internet.

Worse than having no obvious pedagogical improvement or change there seemed in many cases to be a reversion to classroom behaviours from nearly 20 years ago. This is without even considering the equity issues involved in having only one digital class in a school or charging students $400+ a year for the privilege of being in one.

Another argument for change is the "Global Community or Connected" point of view, where students can reach outside their current reality and connect to the world, this implies more radical changes to current practice than the previous "efficiency" argument, because of the way it introduces new ways to expand and enrich the curriculum and through this, it implies that different kinds of pedagogy will evolve to fit these new modes of curriculum and classroom delivery.

There was some evidence of pedagogical change as a result of approaches informed by this standpoint and where this was evident it is generally seen as being a good thing. However, exactly *why* it should be a good thing has not been clearly articulated by hose schools. The changes that occur are usually *ad hoc* responses—new content, new class groupings, or new methods of delivery—rather than concentrated attempts to realize or develop new pedagogical principles.

There was some evidence of teachers teaching students how to interact with each other when using the computer collaboratively so that effective learning can take place. (Eraut 1995; Dawes et al, 2000) Evidence also supported teachers, when ICT was used to promote discussion in small groups and in whole class settings, as this can help to develop students thinking and understanding across the curriculum and across a number of achievement outcomes. (Dawes et al, 2000).

Bernard Hollkner from the Faculty of Education, Monash University speaking at ACEC Conference in 2000 said, "The Cast of Players in a student's learning experiences has increased dramatically. Convergent technologies now allow experts, peers and collaborators to join the student's world, enriching learning experiences."

Pedagogical change, however, is not, in fact, an essential part of the "community building/connect to the world" argument. Even more importantly, this argument does not specify *why* we might expect—or want—pedagogical change, nor does it allow us to see the form we might expect this change to take.

The main argument for ICT adoption or adaption I encountered during my sabbatical was around our current students being "millenials", what Prensky (2001) calls "digital natives" or what Tapscott (1998) terms the "net generation".

Their main argument is that these students have grown up in a digital-rich environment in which ICT—in the form of computers, the Internet, cell phones, personal game machines and mp3 players—is as normal and natural a part of their lives as books, pencils or rugby balls were to the previous generation. These early experiences with ICT are assumed to be formative, in that "millenials" think in ways that are new and measurably different from those of previous generations.

The rhetoric around this argument is that we need new methods of teaching and learning: the "old" ones just aren't going to work with the digital generation. To quote Prensky, "today's students are no longer the people our educational system was designed to teach" (Prensky, 2001, p.1).

There is a lot of talk but very little evidence of this pedagogical change and as Sefton-Green (1998, p. 10) points out, "young people may not, in reality, be quite as *hyper-literate* as some theorists fantasize". While not denying that there have been significant social changes in the last couple of decades, he finds it "surprising that one social development, electronic technology, is being used to explain changes in a whole range of social domains—as if the nature of modern childhood could be attributed to a single cause" (p. 14] Indeed, the "millenial" argument does not provide us with any grounds for deciding what the pedagogical change it implies should look like. *How* should what happens in classrooms change in response to the needs of the digital generation?

A common theme in educational conferences and papers by educationists is the argument that the school system needs a major overhaul if it is to meet the needs of the Post-Industrial "knowledge age" (Gilbert, 2005. Robinson, 2011). The move away from Industrial-Age thinking involves many important developments. For schools, however, the most significant of these is probably the focus on creating *new* knowledge—as opposed to the "old" focus on reproducing *existing* knowledge—and the associated shift in the *meaning* of knowledge. This

shift has major implications for how we think about teaching and learning in schools, especially secondary schools. There is some argument that although the need for change is accepted, whether or not ICT needs to be a major part of that change is still to be proven.

Case-study accounts of educationally uninspired use of computers and other equipment in many schools and classrooms certainly make for depressing reading, and highlight the vast gap between the dreams of the techno-promoters and the realities of students' everyday experiences in schools (Peck, Cuban, and Kirkpatrick, 2002).

You can go into any school in the country to see the Internet being used by students to collect and assemble information, it is, however, far less common to see students using the new multimedia technologies to author and present their work in a range of media to real audiences of peers.
The internet is still generally used as a "take" technology – reading, watching, cutting – rather than as a vehicle for publishing, presenting or collaborating.

The main argument for the computer spend in most of the schools I visited was the increase in engagement for students, however, there was no distinction drawn between engagement meaning being entertained or enjoying themselves versus being engaged as learners, in some schools that difference was not even understood.

The genesis of the argument is that ICT use allows students to work at their own pace, follow their own interests, and connect to "real-world" people and information, that it has the potential to genuinely engage learners—as individuals and groups—with the subject matter, and with their own learning. This is seen as inherently more motivating than the one-size-fits-all pedagogies that were (and unfortunately, remain) a feature of Industrial Age (and much current) education.

It is the availability of these technologies to free teachers to focus on developing the intellectual skills required to do this work well ('well' being the crucial word). To be able to participate successfully in 21st-century society, people will need to go on learning long after they leave formal schooling. To do this, they will need to know quite a lot about learning: how they themselves learn, how others learn, and how to help other people learn.

This part of the work of teachers, while always important, is now absolutely central as a foundation for developing a Knowledge Age education system and indeed, a fully functioning society.

The interesting thing was that some great examples of this sort of learning is happening in some schools that are relatively poorly resourced with ICT, an example of the pedagogy coming before the technology.

Impact on student achievement

The positive impact of ICT use in education has not been proven. In general, and despite thousands of impact studies, the impact of ICT use on student achievement remains difficult to measure and open to much reasonable debate.

Many studies are beginning to support a positive impact as being more likely when linked to pedagogy. It is believed that specific uses of ICT can have positive effects on student achievement when ICTs are used appropriately to complement a teacher's existing pedagogical philosophies. [Cox 2003]

Computer Aided (or Assisted) Instruction (CAI), which refers generally to student self-study or tutorials on PCs, has been shown to slightly improve student test scores on some reading and math skills, although whether such improvement correlates to real improvement in student learning and whether these gains are transferable, remains debatable. [Mann 1999]

Need for clear goals

ICTs are seen to be less effective (or indeed ineffective) when the goals for their use are not clear. While such a statement would appear to be self-evident, the specific goals for ICT use in education are, in practice, often only very broadly or rather loosely defined.

There is an important tension to consider between traditional versus 'new' pedagogies and the current desire for standardised testing where traditional, transmission-type pedagogies are seen as more effective in preparation for standardised testing, which in turn tends to measure the results of such teaching practices, than are more 'constructivist' pedagogical styles. [Johnston 2002]

In many studies there may be a mismatch between the methods used to measure effects and the nature of the learning promoted by the specific uses of ICT. For example, some studies have looked only for improvements in traditional teaching and learning processes and knowledge mastery instead of looking for new processes and knowledge related to the use of ICTs. It may be that more useful analyses of the impact of ICT can only emerge when the methods used to measure achievement and outcomes are more closely related to the learning activities and processes promoted by the use of ICTs. (Voogt J. & Pelgrum H. 2005. Voogt J. 2008)

So to achieve inclusion of ICT in regular pedagogical practice, reasonably explicit requirements need to be included in the schools' curriculum, or in the framework for that curriculum. Voogt and Pelgrum (2005) found that, generally, the change towards the information society entails changes in the design and implementation of educational curricula that address an understanding of the need to develop novel competencies and lifelong learning capabilities that are not addressed in the traditional school curricula.

When it comes to translating these initiatives into new system wide patterns of actual pedagogical practices, local curriculum interpretation will play an important role. Voogt (2008a) argues that 'in IT-supported teaching and learning content, goals, pedagogy and assessment need to be attuned to bridge the current gap between the intended, the implemented and the attained curriculum' (p. 129).

Access outside of school affects impact

The relationships between in-class student computer use, out of class student computer use and student achievement are still unclear. Some studies show students in OECD countries that report the greatest amount of computer use

outside school are seen to have lower than average achievement (the presumption for this is that the high computer use outside of school is disproportionately devoted to computer gaming rather than learning). Not surprisingly studies showed that access outside of school affects user confidence and students who use a computer at home also use them in school more frequently and with more confidence than pupils who have no home access.

One of the most interesting schools of thought is that users themselves believe that ICTs make a positive difference, so in studies that rely largely on self-reporting, most users feel that using ICTs make them more effective learners. No empirical data to back this claim up is available as yet.

There appears to be general consensus that both teachers and students feel ICT use greatly contributes to student motivation for learning. [Holmes 2000. Johnston 2002]

The 'pilot effect' can be an important driver for positive impact

Dedicated ICT-related interventions in education that introduce a new tool for teaching and learning may show improvements merely because the efforts surrounding such interventions lead teachers and students to do 'more' (potentially diverting energies and resources from other activities). (Levin 2002)

Conclusion

A review of the research on impacts of ICTs on student achievement yields few conclusive statements, pro or contra, about the use of ICTs in education. For every study that cites significant positive impact, another study finds little or no such positive impact.

Many studies that find positive impacts of ICTs on student learning rely (to an often uncomfortable degree) on self-reporting (which may be open to a variety of positive biases).

Where ICTs are to be utilised to improve educational quality as measured by most standardized tests, few such gains have been reported.

With sufficient teacher training, and given the existence of a variety of enabling factors, ICTs can be used to impact the nature and types of learning in which students engage.

So what to conclude? Rather than rely solely on my own interpretation of what I have presented I will include concluding remarks by two people that have been influential in this debate, Steve Jobs – founder and CEO of Apple and regular contributor to the Education debate, and John Hattie, who while not being everybody's favourite researcher, has the ear of the Ministry of Education both here and in Australia.

"Technology can't fix education. I used to think when I was in my twenties that technology was the solution to most of the world's problems, but unfortunately it just ain't so," Steve Jobs said in a 1995 Smithsonian interview.

"We need to attack these things at the root, which is people and how much freedom we give people, the competition that will attract the best people. Unfortunately, there are side effects, like pushing out a lot of 46 year old teachers

who lost their spirit fifteen years ago and shouldn't be teaching anymore. I feel very strongly about this. I wish it was as simple as giving it over to the computer…."

"As you've pointed out I've helped with more computers in more schools than anybody else in the world and I absolutely convinced that is by no means the most important thing. The most important thing is a person. A person who incites your curiosity and feeds your curiosity; and machines cannot do that in the same way that people can. The elements of discovery are all around you. You don't need a computer."

This backs up Hatties research where he identifies the teacher as having one of the biggest positive effect sizes in raising student achievement.

Further in that research Hattie identifies the following conditions for effective use of technology or ICT;

"The use of computers is more effective when…

- there is a diversity of teaching strategies
- there is teacher pre-training in their use as a teaching and learning tool
- there are multiple opportunities for learning (e.g. deliberative practice, increasing time on task)
- the student, not the teacher, is in "control" of learning
- when peer learning is optimised
- when feedback is optimised

(Hattie, 2009: 220-227, edited)

ICT is a tool, or series of tools, which have the potential to revolutionise education, but only if their use is planned and based on a pedagogical base that optimises learning opportunities. The most important thing is still the teacher and the philosophy that drives that teaching.

While there is no formula that will guarantee learning for every student in every context, there is extensive, well-documented evidence about the kinds of teaching approaches that consistently have a positive impact on student learning.

At the heart of these proven teaching practices is the concept that students who truly understand and are involved in their learning have accelerated rates of achievement. Assessment-capable students know what they need to learn, where they are with that learning and what their next learning steps are.

At the heart of assessment for learning is the idea, supported by evidence, that students who truly understand and are involved in their learning have accelerated rates of achievement. In order for students to have this participation in their learning, a genuine learning-focused relationship must exist in the classroom.

The success of teaching and learning is founded on the quality of the relationship built between the teacher and the student. The teacher manages the motivational climate of the classroom to foster a learning-focused relationship with students, with a shared ownership of and responsibility for learning. This provides students with the maximum opportunity to build their own motivation to learn.

To create the dynamic in the classroom which enables students to take charge of their learning, teachers need to have, or need to develop, a genuine view of both the students and of themselves as learners (Ako). They must build their own capacity, and also enable students to build theirs, for learning to learn.

Creating a learning-focused relationship aligns with the intent of the wider NZ curriculum, to create competent, self-motivated and involved citizens. It reflects the North Street School aims of developing Positive, Connected, Engaged, Explorers of their own learning.

ICT has a part to play in all of this but only a part to play, it is not a magic bullet and has not yet caused a paradigm shift large enough to remove quality teaching and learning from the heart of an education.

"Teachers are expected to reach unattainable goals with inadequate tools. The miracle is that at times they accomplish this impossible task". Haim G. Ginott

Craig Sharp

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Bibliography.

A"Learning revolution"? Investigating pedagogic practice around interactive Whiteboards in British primary classrooms Gillen, J., Kleine Staarman, J., Littleton, K., Mercer, N. & Twiner, A. (in press)

Analysis schema for the study of domains and levels of pedagogical innovation in schools using ICT. Mioduser, D., Nachmias, R., Tubin, D., & Forkosh-Baruch, A. (2003). Education and Information Technologies, 8 (1), 23-26.

Assessment, accountability and standards: using assessment to control the reform schooling. Torrence, H (1997) in A.H.Hasley, H, laude, P, Brown and A.S. wells (eds) Education: Culture, Economy, Society, Oxford press, 1997, pp 320 – 331.

Assessing the Impact of Technology in Teaching and Learning [Johnston 2002]
Being Young in the Digital Age. Sefton-Green, J. (1998). In J. Sefton-Green (Ed.), Digital diversions: youth culture in the age of multimedia (pp. 1 - 20). London and New York: Routledge. Changing our schools: Linking school effectiveness and school improvement. Stoll, L., & Fink, D. (1996). Buckingham & Philadelphia: Open University Press.

Changing the Conversation about Teaching, Learning and Technology: A Report on 10 Years of ACOT Research [Apple Computer 1995]

Comparative International Research on Best Practice and Innovation in Learning [Holmes 2000]
Conditions for classroom technology innovations. Zhao, Y., Pugh, K., Sheldon, S., & Byers, J. (2002). Teachers College Record, 104 (3), 482-515.

Consultative Workshop for Developing Performance Indicators for ICT in Education [UNESCO-Bangkok 2002]

Creating digital age learners through school ICT projects: What can the Tech Angels project teach us? Rachel Bolstad and Jane Gilbert, New Zealand Council for Educational Research (2006)

Demystifying the digital divide. Warshauer, M. (2003). Scientific American (August 2003), 34-39.

Developing and Using Indicators of ICT Use in Education [UNESCO 2003]

The Digital Disconnect : The Widening Gap Between Internet-Savvy Students and Their Schools [Levin 2002]

Diffusion of innovations (5th edition). Rogers, E. (2005). New York: The Free Press.

Digital horizons: learning through ICT. A strategy for schools, 2002-2004. Revised edition, December 2003. Wellington: Ministry of Education. Retrieved 26 March, 2004 from http://www.minedu.govt.nz/web/downloadable/dl6760_v1/digital-horizons-revision-03.pdf

Digital natives, digital immigrants. Prensky, M. (2001). On the horizon, 9 (5). Available at http://www.marcprensky.com/writing/default.asp

Domains and levels of pedagogical innovation in schools using ICT: ten innovative schools in Israel. Tubin, D., Mioduser, D., Nachmias, R., & Forkosh-Baruch, A. (2003). Education and Information Technologies, 8 (2), 127 - 145.

Evaluation of the Digital Opportunities Project (Notebook Valley). Final report. Wellington: Bolstad, R. (2004). Report for the Ministry of Education, prepared by New Zealand Council for Educational Research.

Extending talking and reasoning skills using ICT Dawes, L., Mercer, N., and Wegerif, R. 2000) Findings from the Teaching, Learning, and Computing Survey: Is Larry Cuban Right? [Becker 2000]

Group work with computers in British primary schools. Eruat, M. Journal of Educational computing Research, 13 pp 61 – 87. (1995))

ICT and attainment: A review of the research literature [Cox 2003]

ICT and curriculum change. Voogt J. & Pelgrum H. (2005) Human Technology 1, 157–175.
ImpaCT2: Emerging Findings from the Evaluation of the Impact of Information and Communications Technologies on Pupil Learning and Attainment [Harrison, C. Comber, C., Fisher, T., Haw. K., Lewin, C., Lunzer, E., McFarlane, A., Mavers, D., Scrimshaw, P., Somekh, B., and watling, R. 2002)]

Impact of Educational Technology on Student Achievement - What The Most Current Research Has To Say [Schachter 1999]
Insight country report, Denmark. Insight – European Schoolnet. Available at: http://insight.eun. org/ww/en/pub/insight/misc/country_report.cfm. Arvedsen N. (2008)

IT and curriculum processes: dilemmas and challenges. Voogt J. (2008) In International Handbook of Information © 2010 Blackwell Publishing Ltd. Technology in Primary and Secondary Education, Vol. 1 (eds J. Voogt & G. Knezek), pp. 43–62. Springer, New York.

Literacy Scores, human capital and growth across 14 OECD countries [Statistics Canada 2004]

Monitoring and Evaluation of Research in Learning Innovations – MERLIN [Barajas 2003]

National policies and practices on ICT in education: Finland. Kankaanranta M. (2009) In Cross-

National Information and Communication Technology Policies and Practices in Education (eds T. Oversold and underused: computers in the classroom. Cuban, L. (2001). Cambridge,

Massachussets: Harvard University Press. Plomp, R.E. Anderson, N. Law & A. Quale), pp. 297–313. Information Age Publishing, Charlotte, NC.

Primary school students' perceptions of interactive Whiteboards Hall, I and Higgins, S. (2005) Journal of Computer Assisted Learning 21, 102-117.

Report on the OECD PISA Student ICT Survey [Australian Council for Educational Research 2002]

School improvement: What's in it for schools? Harris, A. (2002). London: RoutledgeFalmer.

Stages of adoption for technology in education. Knezek, G., & Christensen, R. (1999). Computers in New Zealand Schools, 11 (3), 25-29.

Stepping out of the box: rethinking the failure of ICT to transform schools. Robertson, J. (2003). Journal of educational change, 4, 323-344.

Teachers use of information technology: observations of primary school practice, Aslib Proceedings, 49 pp 97 – 107.

Techno-promoter dreams, student realities. Peck, C., Cuban, L., & Kirkpatrick, H. (2002). Phi Delta Kappan (Feb 2002), 472 - 480.

Technology and Classroom Practices: An International Study [Kozma 2003]

Technology, Innovation, and Educational Change—A Global Perspective [Kozma 2003]

The Digital Strategy: Creating our future: Summary. Wellington: Ministry of Economic Development. New Zealand Government. (2005).

The flickering mind: The false promise of technology in the classroom and how learning can be saved. Oppenheimer, T. (2003). New York: Random House.

The Learning Return on our Educational Technology Investment - A Review of Findings from Research [WestEd 2002]

The Second Information Technology in Education Study: Module 2 (SITES: M2) Case Reports [ISTE 2003]

The knowledge-producing school: Moving away from the work of finding educational problems for which computers are solutions. Bigum, C. (2003) Computers in New Zealand Schools, 15(2), 22-26.

The use of interactive whiteboards in the primary school: effects on pedagogy. Cogill, J. (2003) Research Bursary Reports Coventry, Becta.
Using ICT to Develop Literacy and Numeracy: Research Summary [Institute of Education, University of London 2001]

West Virginia Story - Achievement Gains from a Statewide Comprehensive Instructional Technology Program [Mann 1999]

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