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e-Learning and implications for New Zealand schools: a literature review

Report to the Ministry of Education

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e-Learning and implications for New Zealand Schools: A literature review

Report commissioned by
Ministry of Education

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Executive Summary

This e-Learning literature review examined texts across a range of countries, but within a relatively short time frame of the preceding five years. A range of criteria were used to select or eliminate studies for closer review (see Methodology and Methods section). Some key terms are defined for the purpose of this review: outcomes, e-Learning, tools, affordances, Web 2.0 (see Key Terms section)

In terms of international evidence:

- There is an international doxa about e-Learning's inherent benefits to learners. It masks a relatively small amount of *actual* evidence about its relationship to improved educational and life chances for students.
- The provision of a tool isn't enough, if people don't know what it's for or how to use it, but having them available can precipitate more effective learning relationships (Organisation for Economic Co-operation and Development [OECD], 2005). Perhaps this suggests what teachers need to understand how to get the best out of e-Learning tools: time, space, place, opportunity, and intellectual energy.
- There is a trend emerging in the literature about the importance of teachers' active presence and roles in classrooms using e-Learning tools.
- e-Learning tools can motivate and engage students. These may be critical factors leading to improved educational outcomes.

In the national context:

- Many young people are technologically literate regarding social networking and using mobile technologies as everyday tools, but they may still be neophytes when it comes to understanding how to use them in purposeful and educationally oriented ways.
- Learning in an e-Learning-rich environment may make peer and collaborative learning opportunities easier, thus supporting students' cognitive, affective and social interactions. These ways of working also appear to suit many New Zealand students, including Maori (as outlined in documents such as *Key Evidence*, Ministry of Education, 2008; Bishop and Berryman, 2006) and Pasifika (Franken, May, & McComish 2005). These ways of working may lead to improved educational outcomes.
- The prevalence of e-Learning technologies as natural ways of working in technologically-rich New Zealand schools point to ways in which traditional learning (literacy, numeracy) can be achieved in highly motivating ways. Some of these schools demonstrate both the power of an authentic audience for students' work, and how a school's prevailing ethos about the social and pedagogical frameworks important to learning, becomes a critical factor for success.

In terms of pedagogy and e-Learning:

- e-Learning and collaborative/co-constructive pedagogies appear to be linked.
- The dynamics of classrooms change when e-Learning is part of the regular learning environment.
- Using these pedagogies – that also foster interaction and co-operation - appear to lead to effective learning and better teacher/student relationships.
- Preventing access in schools to mobile technologies or firewalling some sites does not teach effective and critical uses of these technologies that students have ready access to outside of school.

- Gaming/virtual world technologies and mobile phones potentially have a lot to offer education.

In terms of critical thinking and multiliteracies:

- Critical thinking is related to multiliteracies. It is the development of the facility to understand aspects of texts such as agency, motivation, gaps and silences, and political and economic agendas. It is also about purposeful and reflective judgement, involving determining meaning and significance of phenomena, including different kinds of texts. This deliberate critical stance is as important to e-Learning texts as it is to the critique of traditional texts, because it is about higher order thinking skills: Thinking is a Key Competency in the *New Zealand Curriculum* (NZC).
- Pedagogies that feature collaboration and problem-solving tend to involve students in higher order thinking, and support them to retain learning long after they first meet new content and concepts. Through such practices, students are encouraged to talk, pose questions, take risks, experiment, reflect and share ideas. They may even be better at using metacognitive strategies if they have been taught these over time. These same pedagogies appear to link to e-Learning opportunities.
- ‘Multiliteracies’ is a term coined by the New London Group in order to describe what constitutes literacy in the 21st century. The term acknowledges the idea of textual multiplicity. This idea encompasses the technological explosion of what constitutes a text, and considers this in relation to cultural and linguistic diversity and what it means to be literate. Another facet of this definition refers to the agency of making meaning: that this can be a critical factor in social change. Multiliteracies thus closely link to e-Learning affordances and provide opportunities for students to learn in ways that have become natural for them.

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Background

This review, commissioned by the Ministry of Education, seeks to principally address two key questions:

- What is the nature of existing evidence linking e-Learning to improved learning outcomes for students in primary and secondary schools?
- What teaching and learning practices maximise (any) benefits of using e-Learning?

These questions provide the scope and framework for the literature review, which is in turn to inform the development of e-Learning policy and projects intended to support students' learning throughout their schooling. Thus the review outlines the nature of existing e-Learning evidence related to school students' learning outcomes and explores key ideas related to pedagogical practices that best link the e with learning. The literature review is designed to:

- Identify what constitutes high quality evidence of effective teaching and learning in relation to e-Learning
- Examine relationships between e-Learning and effective teaching and learning in primary and secondary schools via the research literature evidence, both nationally and internationally (as identified in the RFP)
- Provide the findings for the design of a teacher-as-audience summary of the literature review so that schools can more readily contextualise the findings for their own e-Learning development purposes.
- Examine evidence related to student outcomes and e-Learning
- Identify gaps in both research and potential areas of interest for initiatives, thus providing the Ministry of Education with the evidence for possible directions for subsequent e-Learning professional development and research projects, such as the Digital Opportunities and Software for Learning programmes

In order to achieve the above, it is necessary to:

- outline the New Zealand educational context of the review
- define important key terms, such as 'outcomes', 'e-Learning' and 'affordances'
- explain the literature review methodology and methods
- identify the nature of the evidence and key trends and themes, and
- explore implications for schools.

New Zealand educational context

- The section reviews the policy framework related to learning, e-Learning and the future profile of learners. It notes key points in policy documents that link to connectedness and the role of e-Learning in supporting current and future learners.
- The section notes the growing ubiquity and affordability of technologies which can be harnessed for learning purposes, and how this pushes against regulatory and rule-bound frameworks in schools.

This review takes cognisance of the policy context of education in New Zealand, and positions it inside key ideas about education, curriculum, pedagogy and learning as outlined in relevant policy documents. These include the *New Zealand Curriculum* (Ministry of Education, 2007), the *Key Evidence* document related to Ka Hikitia (Ministry of Education, 2008), and the Ministry of Education's outline of what a 21st century learner needs (Ministry of Education, 2006).

These, along with other complementary documents, are briefly explored in order to highlight the trends and concepts important to the review's key focus of learning outcomes and e-Learning.

The *New Zealand Curriculum* (NZC) outlines for both English medium and Maori medium classes the overarching vision, principles, values and key competencies of the "official policy relating to teaching and learning... in New Zealand schools" (Ministry of Education, 2007, p. 6: English version). Essentially, the expectation is that students emerging from our schools will be "young people who will be confident, connected, actively involved, lifelong learners" (p. 7), regardless of whether they are using Maori or English as their first language. The words 'connected' and 'actively involved' in the quoted statement can easily refer to digital connections and the sorts of social networking that many young people already engage in, and which can be harnessed educationally. The extent to which these tools and abilities are, or may be, purposefully harnessed educationally in our schools is part of the brief of this review, along with examining the pedagogical issues hinted at in connecting and actively involving students in lifelong learning. A 21st century lifelong learner will, as outlined in various policy documents (such as Ministry of Education, 2006), need to be proficient e-Learners, since many information sources will be accessed digitally.

The *Key Evidence* (Ministry of Education, 2008) document reports that when schools focus in meaningful ways on addressing the learning needs of Maori and aim for improved learning outcomes, achievement gains can be huge. While the concept of 'outcomes' will be addressed shortly, there is a clear link made with "emphasising good pedagogy" (p. 18). This particular idea, of a close relationship between pedagogy and outcomes, is pertinent to a review of e-Learning, since there is a clear trend linking co-constructive and student-centred pedagogies and e-Learning. This also links to the NZC policy framework focus on 'Effective pedagogy' (Ministry of Education, 2007, pp. 34-36), which outlines the practices and knowledge considered important in fostering positive learning relationships with students. As in the *Key Evidence* document, this highlights the critical role of teachers in facilitating effective learning spaces (for example, temporal and intellectual), places, and practices, and harmonises with the evidence from Te Kotahitanga, which asserts that effective relationships between students and teachers are necessary for learning (Bishop & Berryman, 2006).

The futures orientation implied in the *New Zealand Curriculum* (NZC) is echoed in the e-Learning Action Plan (Ministry of Education, 2006), which asserts that, "today's students need to be confident and capable users of ICT and to understand how to use ICT effectively across the curriculum" (p. 8), and that "e-Learning can contribute to the development of the [key] competencies" (as outlined in the NZC) and observes that these competencies should be "applied in ICT-rich contexts for all students" (p. 8). This implies that such tools are readily available and used in schools while iterating that the "most significant within-school factor" (p. 9) contributing to student achievement is the quality of the pedagogy teachers provide. Teachers who use ICT routinely in their classrooms are more likely to be attuned to students' learning needs, and allow a much greater level of interaction and collaboration to take place (OECD, 2005). These ideas are iterated as strong possibilities in *The New Zealand Curriculum* and a range of national and international reports (CERI-KERIS *International Expert Meeting: ICT & Educational Performance*, 2007; Cowie et al., 2008; Campbell, 2001; Gilbert, 2005; Ham, 2009; Johnson, Levine, Smith, & Stone, 2010; Mentis, 2008; OECD, 2005; Somekh, 2007). Such pedagogic practices are in tune with learning environments encouraging reflection, collaboration and co-operation, connections to prior learning, ample opportunities to grasp new learning, and an inquiry focus. These are the kinds of pedagogical actions envisioned in NZC and reflected in the *Key Evidence* document. The centrality of teachers to e-Learning/ICT-rich classrooms is discussed more fully in a specific section of this review related to pedagogy. And in any discussion of e-Learning, the term 'ICT' must be addressed; it is the 'communication' in the IT that is critical for our purposes, and this will be addressed specifically later.

Also relevant to this discussion are the several trends outlined in the latest *Horizon Report* (Johnson et al., 2010), because these hint at directions for e-Learning. The first and foremost of these trends identifies mobile technologies as having the greatest significance for education. The second argues that pedagogy has a central place, especially when it

involves “hands-on, purpose-driven, authentic, and other active learning approaches” (p. 2). The third trend identifies the “increasing connectedness of people around the globe” (p. 3) as having significance in education. The final trend is the increased capability of computer technologies to deliver connectedness coupled with greater affordability; there is a growing ubiquity of technological tools. These trends are considered in this report to be crucial for education, especially since technology developments are creating an increasing “user-centric nature of internet applications and tools” (p. 3).

The regulatory framework in which teachers operate is also a contextual factor. Two important features for secondary schools, as an example, are the regulatory regime of qualifications and the compartmentalisation of subjects into timetables, which may affect students’ ability to deeply engage in learning with and through technological tools. This is explored later in the review. There are also the complications of staff and students’ regular access to the tools themselves, coupled with the effects of firewalls and other safety and security protocols that schools maintain. These provisions are usually designed to block access to objectionable sites and to avoid viruses, for example, but they can also block access to potentially useful sites. These issues are relevant across all education sectors. For example, the *Horizon Report* acknowledges that “security concerns often go too far” (p. 3) when it discusses the limiting effects of specific firewalls and security protocols for tertiary education. Schools struggle, it would seem, to strike a balance between security/safety and access for learning. Such frameworks and contexts, including the ability of schools to fund and sustain e-Learning affordances, are important to acknowledge.

What follows is a clarification of key terms used in this review. These include: ‘outcomes’, ‘e-Learning’, and ‘affordances’ and Web 2.0.

Key terms

This section defines a range of terms used regularly in this review: outcomes, e-Learning, tools, affordance, Web 2.0. The terms arise partially from the RFP for the review, and partially from the documented evidence regarding e-Learning itself. The first term addressed is ‘outcomes’.

Outcomes

This term is often understood to be a direct synonym for achievement. However, given that the use of ICT tools in a learning context is usually a means to an end rather than the end itself, it makes attributing direct causal links between achievement and e-Learning very difficult. Other complicating factors in classrooms relate to aspects such as students’ prior knowledge, their familiarity with the tools, the content being learned, and the pedagogical skills of the teacher. Any of these factors could confound attempts to directly link achievement with the use of e-Learning tools. It is thus sensible to interpret the term ‘outcomes’ more broadly so that it better reflects the wider contexts of learning in schools, and how this might be done is examined next. Several documents were examined to arrive at workable parameters for this definition. Two important ones were the diverse learners Best Evidence Synthesis (BES) (Alton-Lee, 2003), and the BES relating to teachers’ professional development (Timperley, Wilson, Barrar, & Fung, 2007). To begin with, the diverse learners BES (Alton-Lee, 2003) interprets ‘achievement’ widely, to encompass:

the essential learning areas, the essential skills, including social and co-operative skills, the commonly held values including the development of respect for others, tolerance (rangimārie), non-racist behaviour, fairness, caring or compassion (aroha), diligence and hospitality or generosity (manaakitanga) (p. 7).

When the same BES addresses ‘outcomes’, it suggests that they include attitudes to learning, as well as “behaviours and other outcomes demonstrating... shared values” (p. 7). Specific educational outcomes include:

cultural identity, well being, whanau spirit and preparation for democratic and global citizenship. Desired outcomes reflect the New Zealand Curriculum Framework and the philosophy of Kura Kaupapa Māori (p. 7).

The Timperley et al. (2007) BES also indicated a preference for a broad view of outcomes, encompassing the range of the “academic, social, personal or performance” (p. 18). These can be understood to relate to social, affective and cognitive domains of learning, all of which are important for learners to develop while at school. The *New Zealand Curriculum’s* (NZC) Vision statement, Principles, and summary of Effective Pedagogy (see pages 34-35) can be interpreted as indicators of outcomes reflecting social, cultural and economic aspirations linked to educational attainment. The Key Competencies clearly suggest desired skills and abilities that schools should foster in their learners. These link closely to BES interpretations of outcomes.

As well as the Key Competencies, the Principles in the NZC “embody beliefs about what is important and desirable in school curriculum” (p. 9), and outline how “planning, prioritising and review” (p. 9) inform curriculum practices and firmly centre attention on students and their educational needs. These Key Competencies therefore imply strategic and deliberate pedagogical planning on behalf of teachers. In turn, this implies the deliberate incorporation of technological tools to enhance learning opportunities and support meeting educational need. The eight statements in the NZC regarding the Principles include references to teachers having high expectations of students. Other statements refer to cultural diversity, inclusion, learning how to learn (or metacognition), coherence (that is, linking across and between subjects), considerations of the future, and the social goal of linking with the wider community. These latter statements

imply a goal of lifelong learning and good citizenship, and link to teachers paying attention to technologies at the centre of students' lives and using them educationally.

To achieve desired outcomes related to lifelong learning, a focus on only academic achievement as a synonym for outcomes could potentially be counter-productive because lifelong learning suggests a preference for openness, seeking out knowledge, testing ideas, experimenting and changing ideas based on new knowledge and evidence. If academic achievement was the single criterion for outcomes, lifelong learning may be stifled, because the practices of school learning would necessarily be fixed only on immediate qualification needs rather than on including the capacity to learn beyond school and develop skills important to learning with others. A wider view implies equipping students with broad metacognitive and self-reflective skills that also include the capacity for critical thinking. These skills and abilities are alluded to in later sections, and have implications for teachers' pedagogical thinking and actions as they use e-Learning tools in classrooms.

An international example regarding outcomes is Singapore's Ministry of Education's documents identifying their 'desired outcomes of education' (Ministry of Education, Singapore, n.d.). These specifically refer to "post-secondary and tertiary students" but imply what must have come before to achieve these outcomes. Singapore's include becoming "morally upright, ... culturally rooted yet understanding and respecting differences, ... responsible to family, community and country", "... willing to strive, take pride in work, value working with others", "... able to seek, process and apply knowledge", "... innovative - [having] a spirit of continual improvement, a lifelong habit of learning and an enterprising spirit in undertakings", and "... able to think, reason and deal confidently with the future, [having] courage and conviction in facing adversity". These long-term outcomes go beyond a narrow focus on passing exams or gaining qualifications, focusing instead on the kinds of aspirations that resonate with the Values and Principles of *The New Zealand Curriculum*.

Thus, when these views about the potential meanings for outcomes are considered together, encompassing a broader view beyond causal links to academic achievement is necessary. This literature review therefore focuses on texts that link to student and teacher outcomes in the social, affective and cognitive domains. These outcomes can include items such as:

Student outcomes

- Learning how to learn/metacognition
- Engagement/positive attitudes to learning
- Concentration on, and completion of tasks
- Taking learning outside the classroom
- Developing social skills – discussion, co-operation, task completion, inclusion, sensitivity to difference and diversity, building effective relationships
- Articulating opinions on and about their learning
- Improving basic skills of literacy and numeracy leading to improved products of learning such as written reports, visual or oral presentations
- Improving quantitatively in common tests.

Teacher outcomes

- Improved confidence with, and knowledge about, e-Learning practices and tools
- Improved understanding and consistent use of appropriate pedagogies that support learning
- Improved relationships with students including an appreciation of their prior knowledge, diverse backgrounds, and capacity to learn
- Seeking regular feedback from students about their learning in order to improve practices and relationships
- Greater satisfaction and engagement in designing and implementing effective pedagogical practices
- Developing an inquiry approach focused on improving students' learning outcomes which link to both subject specific outcomes, and Key Competencies.

These outcomes interpret factors in the social, affective and cognitive domains for both teachers and students. In turn, they map onto qualities such as collaboration, motivation, perseverance and higher order thinking. Pedagogy and what is perceived to be effective learning is also implicated. As Dillenbourg (2008) cautioned, Internet or mobile technologies coupled with education do not necessarily predict learning outcomes. Instead, the ways that teachers use these affordances have a strong link to this potential. Therefore, given that there are difficulties in making direct causal links between e-Learning improved academic achievement outcomes for students, it is important to interpret 'outcomes' widely as indicated above.

e-Learning

This term is explained in the New Zealand Ministry of Education's e-Learning action plan as "Learning and teaching that is facilitated by or supported through the smart use of information and communication technologies" (Ministry of Education, 2006, p. 2). These information and communication technologies (ICTs) include tools such as interactive whiteboards (IWBs), handheld devices like cell phones, digital cameras or voice recorders, or PDAs (personal digital assistants), as well as computers and specific software applications. For educational purposes, the most important word in ICT is 'communication' – the ability to receive, create and transmit information and/or new knowledge using a mediating technological tool of some kind. As Earl and Forbes (2008) argued, the word 'communication' "emphasises the purpose behind using a wide range of technologies in educational contexts – that is, the central focus should be.... on how [these technologies] may be used to enable connections between people" (p. 195). These connections also imply interactions. 'Smart use', as used above, is potentially a key part of the definition, for it implies practices that are strategic, nimble, just-in-time, and pedagogically appropriate.

Digital Horizons (Ministry of Education, 2002), an earlier document, defined e-Learning in much more detail as:

flexible learning using ICT resources, tools, and applications, and focusing on interactions among teachers, learners, and the online environment. e-Learning usually refers to structured and managed learning experiences, and may involve the use of the internet, CD-ROMs, software, other media, and telecommunications (p. 5).

This definition centres attention on 'interactions' and the role of the teacher in providing 'structured and managed learning experiences'. The term 'interactions' recognises the importance of communication and relationships as a feature of the learning and the pedagogy. The 2006 definition streamlines the one used in *Digital Horizons*, subsuming the tools as integral and understood components of ICT: interaction and communication go together with the use of

digital tools. Other definitions are also valuable to examine. For example, in their *Glossary of Library and Internet Terms*, the University of South Dakota defines e-Learning as:

Any technologically mediated learning using computers whether from a distance or in face to face classroom settings (computer assisted learning) (University of South Dakota, n.d.),

while the Australian Flexible Learning Framework describes e-Learning as a component of flexible learning, involving:

the application of electronic media in the delivery of flexible vocational education and training programs. It can include the use of web, CD-ROM or computer-based learning resources in the classroom, workplace or home, as well as online access to course activities such as group discussions and online assessment activities. (FLAG Secretariat, 2003)

Both of the above definitions refer to the mediating role of electronic media, particularly a computer, and the flexibility of place and time in engaging in the learning. Neither mentions tools and media such as podcasts or mobile phones; however, this may simply reflect the age of the definition. The rapid development of mobile technologies in the past five years as everyday tools, and therefore potential learning tools, was not predicted in these definitions.

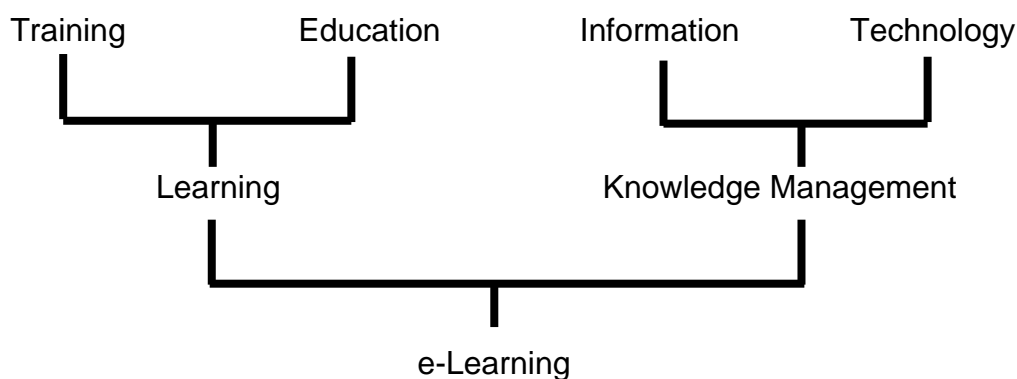
The Canadian Council on Learning's recent report (Abrami et al., 2008) decided on a definition from 2002: that e-Learning is "the development of knowledge and skills through the use of information and communication technologies (ICTs), particularly to support interactions for learning – interactions with content, with learning activities and tools, and with other people" (p. 30). This definition focuses on the idea of 'interaction' as a key feature of e-Learning, and is close to acknowledging the key role pedagogy plays in effective learning.

Wan, Wang & Haggerty (2008) suggest that e-Learning is:

a virtual learning environment in which a learner's interactions with materials, peers and/or instructors are mediated through information and communication technologies. It is different from the traditional environment because ICT are used as tools to support the learning process. Taking advantage of network infrastructures, learning can occur anywhere using many types of resources." (p. 513)

This definition focuses on the idea of a 'virtual learning environment'. Wan et al. also suggest the relevance of mobile technologies to e-Learning, and describe a potential learning environment that eschews the need for traditional physical classroom spaces. While this resonates with trends identified in the latest *Horizon Report*, it is unlikely that schools will cease to exist, that classrooms will disappear, or that teachers will be redundant. Instead, their relationships to learners and how learning happens will evolve. There is also a body of literature suggesting that teachers are still crucial to 21st century learners, and this will be considered later in the review.

Some concepts are, however, implied in all of the above definitions. *Interaction* is one of these, referred to also as *discussion*. Another is the concept of *mediation* - that the e-Learning tools are the means by which the interactions can take place. *Connectedness* is also implied, and this links to the idea of *social networking*, or *communication* with others. This can be understood as a community of practice/learning framework that also resonates with Lave and Wenger's explanations of situated learning (1991). e-Learning is thus related to a confluence of ICT, education, and knowledge. A diagrammatic way of viewing this confluence follows:

Figure 1: Merging language and fields of study

(*What is Electronic Learning?* n.d. p. 3 found at www.mup.com.au/uploads/files/pdf/978-0-522-85130-4.pdf)

For the purposes of this review, the New Zealand Ministry of Education's most recent definition as outlined at the start of this section applies here, since it links together the tools, learning opportunities, the scope and design of such practices (Ministry of Education, 2006).

Tools

The word 'tools' should also be examined in this review's context. Its relationship to education was articulated well by Sutherland (2004), who pointed out that tools are used regularly in classrooms as a matter of course. This should be no surprise, since "all human activity is mediated by tools" (2004, p. 6), which can be understood to include materials, symbols and objects. Cultural artefacts are tools, as is language. More prosaic tools include pens, books and paper, while digital tools include specific software programs, the Internet, plus specific hardware such as cell phones or computers. People can also operate as tools because they can help others complete a task or develop new knowledge, and this links to the importance of teachers as facilitators of knowledge creation in classrooms. Thus, the understanding that teachers use tools is not new. However, their use of digital tools has much shorter history for those used to books, pens and other 20th century tools for learning; overhead projectors and cassette tapes were new tools for educational use less than twenty years ago. Sutherland asserts that tools "qualitatively change the flow and structure of an activity...[and] in this sense tools both enhance and constrain an activity" (p. 6). Digital tools, like other kinds, can be both helpful and obstructive in learning contexts. 'Tools' is a term used regularly in this review, and is intended to be understood as referring to the kinds of digital uses and objects outlined in this section.

Affordance

The next word important to examine is 'affordance' because it is regularly used in relation to ICT (Johna & Sutherland, 2005). This term, as used in psychology, refers to elements that allow people to perform actions: for example, an object or specific environment that supports possible and actual actions. In relation to ICT/e-Learning contexts, it has shifted in meaning to refer to suggested or intuitive uses, and may refer to abstractions rather than objects per se. For example, a web page deemed to have good affordances, is one that users can navigate easily and quickly discover what symbols/icons/graphics or text can do that helps complete a task or make progress. In other words, its design features help a user know what to do; that its visual layout and content leads users to predict certain actions and consequences (Abrami et al., 2008). This is particularly evident in the ways that mobile devices are beginning to be used educationally, and can be seen in the explosion of Apps (Applications) for the iPod Touch and iPhones, compared with other mobile devices such as mobiles called smartphones, which appear to require much more prior knowledge and support to manipulate successfully.

Conole and Dyke (2004) reinforce the idea of potential when linking affordance with e-Learning. They suggest that people can respond creatively to technologies and adapt them in ways that original designers had not foreseen. For example, Johna and Sutherland's (2005) examination of secondary schools' uses of ICT referred to the pedagogical affordances of ICT and what it suggests for the future. In the UK for instance, the policy framework of personalised learning expects an increasing use of digital technologies in schools to support it (Underwood & Banyard, 2008), and is associated with assumptions about digital technology affordances in education. On the other hand, Luehmann's (2008) discussion about the affordances of blogging to support teachers' building of the attitudes, skills and understandings that lead to improved student learning, shows that the potential uses are not yet exhausted for either teachers or learners. These tools, and other such online communities of practice, help teachers focus on reflection and wondering, thus providing a means by which they are able to 'see' themselves as teachers differently. This may also be helped by the kinds of reactions they get from those who comment on their postings.

Affordances can be linked to actions such as "mashing and modding" (Grenfell, 2007). These refer to the processes of modifying (modding) and adding (mashing) to existing tools, affordances and programs, and describe what already happens with Web 2.0 tools. In other words, users take over an existing product and make it their own, thus creating new ones or new versions of what has gone before, sometimes particularising and improving them.

In summary, 'affordance' is a term that refers more to the level of intuitive ease with which users can manipulate or navigate e-Learning tools without needing either much tool-specific prior knowledge or too many existing e-Learning skills to do so.

Web 2.0

This term refers to the kinds of web affordances which promote interaction, social networking (that is, the ability to connect digitally to anyone, anywhere both synchronously and asynchronously), mashing and modding. Web 2.0 describes the kinds of programs which allow users to create content rather than remain as passive recipients of WWW site information. With Web 2.0 affordances, people may now both publish and create their own content using a range of media, and allow others to provide feedback on it, particularly in social networking spaces. It is quite common for individuals to post images and movies on various sites for the express purpose of garnering feedback. Bebo, Facebook, Podcasts, and YouTube are examples of such sites.

Web 2.0's flexibility doesn't stop there. People can also collaborate on documents and software. Blogs, Wikis, and GoogleDocs are now common examples of these affordances, and Wikipedia is probably the most famous. CreativeCommons is an Open Source (non proprietary) example of an international network designed to share knowledge and skills, and communicate these widely as a public good. These kinds of tools may be useful to harness educationally. It is now time to explain the methods used to examine texts for this review.

Methodology and methods

- Methodologically, this review had a tight time frame for completion, and for the years of interest (2004 to present). It also sought to examine texts from the following range of countries: USA, UK, Australia, NZ, Singapore, Scandinavian countries.
- The review discounts texts that principally focused on the tertiary sector, or which failed to address any of the ideas about outcomes canvassed in the definitions section of this review.
- The process for selecting and rejecting texts for closer scrutiny is outlined, and the approach to quantitative and qualitative studies is explained.

The relatively tight time-frame for this review meant that priorities were established to expedite the process. The first priority was settling on definitions of key terms such as ‘outcomes’. The review also needed to focus on sources available mainly within the last five years, including theses, journal articles, conference presentations, and reports relating to e-Learning and the compulsory schooling sector. This eliminated most texts that contextualised e-Learning in higher education, although a few were used because of the ideas they highlighted for the compulsory school sector. A third priority was linking e-Learning and student outcomes, while the next priority was to find texts which linked to teachers’ dispositions, pedagogy and e-Learning as factors in positive and deliberate classroom practices. The final priority was to select texts from targeted countries, particularly New Zealand as well as USA, Australia, UK, Singapore, and Scandinavian contexts. Singapore and Scandinavian contexts are of interest because they have widely available/free high-speed wireless, and this implies the potential for the wide use of e-Learning technologies in classrooms and beyond. However, even in these countries there are issues, as Krumsvik (2009) suggested about Norway’s educational use of these tools.

A key methodological issue to establish was what constituted evidence of e-Learning and outcomes. How these are interpreted for this review has been addressed earlier. Given that schools and classrooms are complex and fluid places, undertaking empirical research to establish causal links between these phenomena is difficult. While there are those who believe that “reliable and valid objective measures are necessary if we are ever to achieve true integration of information technology in education” (Maddux & Johnson, 2009, p. 1), qualitative research methods developed precisely because such objectivity was shown to be almost impossible to achieve as Richardson (1997) argued in a seminal work on methodological objectivity and interpretive social science.

Many qualitative articles about ICT/e-Learning examined for this review, were richly descriptive of what happened and how, but thin on examining impact or outcomes. Quantitative studies demonstrating effect sizes of interventions referred to specific situations too, but sought to explain what happened in objective ways and sometimes make larger claims. Potential impediments important in educational contexts, such as how people felt on the day, what they already knew, or even what impact the environment might have had on any measure used to gather quantitative data in such settings are seldom addressed. Instead, it is common for quantitative studies to focus only on specific items of analysis separated out from the entire classroom context. The effects of contextual matters such as The Hawthorne Effect (this is explored in more detail later) therefore tend not to be addressed. Thus, the methodological basis for many of the studies’ conclusions examined for this review (whether qualitative or quantitative) are such that caution is required in applying findings to wider contexts.

In searching for reports, journal articles, theses and texts such as conference presentations (which may exist as slideshows or videos), a range of key words were systematically used to select, reject, review and summarise concepts,

ideas, methods and findings. For example, key words included various forms of the word *e-Learning*, and included combinations of terms such as *ICT, classrooms, pedagogy, outcomes, engagement, affordance, tools, co-construction, collaboration*. As the review progressed, terms were refined in relation to what achieved the most hits. Various electronic databases were searched such as Proquest, ERIC and A+ as well as NZCER's thesis database.

Some methods were used to short-circuit the process. For example, one of these was scanning pdfs using key words (such as *outcomes, engagement, pedagogy*), which helped select or reject the work for more detailed reading. During the scanning process, sections of pdfs were highlighted for future reference using tools within Preview, a pdf reader. While these were quick selection strategies, they may have unnecessarily rejected what might otherwise have been useful articles, and thus may have limited the review. Another short-circuit device was to use tags in the Zotero bibliographic collection to link articles and sources together using specific terms. This again helped group texts into specific theme/keyword areas.

This summarises the basic methods used to select, scan and thematise texts for inclusion in this review. The next section describes the nature of evidence regarding e-Learning, schooling, and outcomes.

Nature of the evidence

Over 250 articles were examined in relation to this review. Over half (approximately 130) were rejected for not fitting one or more of the priorities noted earlier. For example, many were rejected because of their focus on tertiary e-Learning, or because they did not link to at least one of the potential definitions of outcomes. As well as these articles, 25 international and national reports were examined for this review, and approximately 40 New Zealand and other theses. Over 300 items (theses, reports, articles, and artefacts such as conference videos or other forms of presentations) in total were examined for this review. The reference list for this review is therefore a subset of the total sources scanned using the criteria for the search outlined earlier.

The sections that follow next broadly scope international and national evidence. Keeping these distinctions however, is relatively arbitrary and comparisons across these two areas are made at various points to highlight key ideas and linkages.

International evidence

International studies featured the following:

- There is an international doxa about e-Learning's inherent benefits to learners. It masks a relatively small amount of *actual* evidence about its relationship to improved educational and life chances for students.
- The provision of a tool per se isn't enough for it to be good for learning, if people don't know what it's for or how to use it. Perhaps this suggests what teachers need in order to engage in understanding how to get the best out of e-Learning tools: time, space, place, opportunity, and intellectual energy. However, the provision of e-Learning tools can precipitate more dynamic and effective learning and more positive learning environments (OECD, 2005).
- There is a trend emerging in the literature about the importance of teachers' active presence and roles in classrooms using e-Learning tools.
- e-Learning tools can motivate and engage students and have a positive impact on a learning environment. These may be critical factors leading to improved educational outcomes. When teachers see the positive effects on students' engagement and concentration when e-Learning is integrated into learning, they tend to want to repeat such opportunities.

Reports emanating from Australia, Great Britain, Canada, USA, Singapore and Scandinavian countries such as Norway and Finland were searched in order to understand the policy contexts around e-Learning and ICT. Most reports which flag national policies about e-Learning also link it to educational outcomes, and assert that e-Learning is beneficial, but can, Bourdieu terms, be understood as *doxa* (Grenfell, 2007). Doxa is a term which refers to that which is considered to be a given; something that needs no explaining, but which may be perceived as fact, when it is not. This international doxa about e-Learning's inherent benefits to learners masks a relatively small amount of *actual* evidence about its relationship to improved educational and life chances for students. While 'outcomes' is a term referred to consistently in governmental policy documents vis a vis learning, what it practically means is not always clear.

The aspirational nature of these policy documents often foregrounds the importance of teachers embracing such technologies because of their asserted benefits for learners. For instance, the British organisation ESRC's Teaching and Learning Research Programme outlined some key findings in a classroom-focused inquiry. This included a survey of 250 teachers across the primary and secondary sectors and an audit of schools' IT structures. The report explaining how IT networks supported change "confounded expectations" because the report found that "while IT is now a well-

established element of classroom practice, teachers made little use of electronic networks to develop their own professional practice, even when they were part of networks designed to help them do so” (James, 2006, p. 3). One implication of this is that provision of the tool isn’t enough, if people don’t know what it’s for or how to use it. Perhaps this also hints at what teachers need in order to engage in understanding how to get the best out of such networks: time, spaces, places, opportunity, and intellectual energy.

The role of the teacher is also addressed in another research brief report in the same series which noted that, “ICT can help learners to engage with lesson content and influence the course of lessons, but not always in the way intended”. The implication was that “teachers should be aware of the need to intervene during ICT tasks so that pupils achieve learning” (Kennewell, 2008, p. 1). This points to a trend emerging in the literature about teachers’ active presence and roles in the classroom. This is reinforced in the New Zealand government’s e-Learning Action Plan, (addressed in the next section) and reflects the importance of teachers’ pedagogical practices in e-Learning classrooms.

The BECTA final report into the use of ICT in schools and its effect on teaching and learning in UK schools found that as technology became embedded into the natural flow of schooling, schools’ national test outcomes “improved beyond expectations” (Somekh, et al., 2007, p. 6). The longitudinal study over five years aimed to examine the extent to which high levels of ICT resources could enable 28 schools and 3 further education institutions to “change the life chances of children and young people in areas of socio-economic disadvantage” (p. 3). The funding was such that these educational institutions could access both hardware and software resources, as well as professional development, training support and classroom release for teachers. The evidence gathered for the final report was both quantitative (benchmarking changes in national test data; modeling of e-maturity to track institutional change over 4 years; annual teacher, student and parent surveys), qualitative (site visits to classrooms, interviews with stakeholders, document analysis) and action research data (over 90 teachers and others completed 116 action research studies of their ICT trials).

Key findings of this final report concluded that gains were greater for primary-aged students, and that the use of ICT tools regularly improved the quality of interactions between teachers and students, leading to greater learner-initiated choices. Other aspects, such as electronic registration “improved attendance in some schools” by up to four percent and “to enable learners to get the maximum learning benefit from using the internet, internet protocols that safeguarded learners’ welfare without being overly prohibitive were required” (p. 5). Graphs in the report plotted the comparison of performance in Key Stage 2 English, demonstrating both the wide gap in the starting point of the students in these 28 schools in 2002 compared with the national averages, and the dramatic improvement in their achievement rates by 2006.

Through more personalised learning (ie such as working in smaller groups, and identifying individual learning goals), students grappled with content and concepts in classrooms primarily focused on their needs (Somekh et al., 2007). Perhaps this was as important for the learners’ improvements as the availability of new technological tools. The ability to develop and consistently feature learner-centred pedagogical practices is seen as significant in maintaining both student motivation and effective classroom relationships, particularly in New Zealand classrooms and with Maori students (Bishop & Berryman, 2006).

The point about the embedding of technological tools into the natural flow of schooling is important. It iterates the need to integrate, authenticate and develop purposeful learning, which is the role of the teacher. The PISA report into the readiness of students to fully take advantage of a technology rich world (OECD, 2005) noted that

An effective use of ICT in schools can have an immediate positive impact on schools’ learning environments, for example by: creating more dynamic interaction between students and teachers, increasing collaboration and teamwork in problem-solving activities, stimulating creativity in both

students and teachers, and helping students to control and monitor their own learning. (OECD, 2005, p. 9)

It is clear then, that these conditions need effective pedagogical actions to translate these opportunities into actual learning outcomes. There are differences, however, in primary and secondary school results when using such tools. In terms of these differing results, the BECTA report alluded to earlier (Somekh et al., 2007), suggested that one relevant factor is the ability of primary classrooms to flexibly respond to students' engagement in integrated project work across the curriculum. In such cases, timetables are more flexible, allowing for greater time to be spent on specific tasks, so that students do not need to respond to timetable period bells. This finding echoes the PISA findings outlined in the quote above. The BECTA report also noted that students in classrooms containing technologies such as IWBs and other capture/display tools (digital cameras, for instance) could more easily 'see' or visualize material that was otherwise relatively abstract or difficult to access in other formats. Video formats were especially useful for students with disabilities. For example, their learning behaviours could be filmed for their own critique as means for improvement. The same technologies were useful for developing a broader range of students' acting and other performance-type capabilities, as well as recording field trips, science experiments, or sports movements. In other words, this BECTA report noted a wide range of positive outcomes when ICT use was embedded into the fabric of a school's learning opportunities. These outcomes reflect the learning environment conditions ICT/e-Learning tools can promote, as noted in the OECD (2005) report.

As indicated earlier, there are some issues with the rhetoric and the reality regarding e-Learning and outcomes. While there is growing evidence of a positive influence of using interactive whiteboards (IWBs) in classrooms on teachers' pedagogies in UK research (Johna & Sutherland, 2005; Kent & Holdway, 2009; Lee, 2003; Lewin, Somekh, & Steadman, 2008; Reisz, 2009; Somekh, 2007), and evidence of a relationship between regular ICT use (especially of digital media tools) and improved literacy and numeracy (Kent & Holdway, 2009; Lee, 2004), the influence of contextual factors, which are often glossed over in reports of digital tool use, cannot be discounted. Key factors are the pedagogical practices of teachers and their deliberate acts of teaching. If teachers do not actively teach students how to use technological tools educatively for authentic learning purposes, very little will change for learners (Lee, 2003). Contextual factors include the:

- knowledge and confidence of the teachers,
- ready access students and teachers have to ICT tools,
- prevailing pedagogical thinking in the school,
- leadership and technical support available,
- social cohesion of the classroom, and
- the extent to which students have an audience for their work (Bennett & Lockyer, 2008; Kent, 2004).

The points about audience and the prevailing pedagogical thinking in a school are reflected in the example of the podcasting and television productions from New Zealand's Pt England School, which demonstrate the power of both an authentic audience for students' work, and a prevailing ethos in the school about the social and pedagogical frameworks important to learning. These factors are captured in an e-Learning fellow's investigation in this school (Burt, 2007).

It is important to note that most sources already cited in this section (except for Johna and Sutherland's study as outlined earlier), took place in primary school settings. This may suggest areas of further investigation into what the impediments may be for uptake in secondary school settings.

A meta-analysis of online learning (Means, Toyama, Murphy, Bakia, & Jones, 2009) conducted for the US Department of Education focused on studies which used ‘controlled design (experimental/quasi-experimental design)’ (p. 11) processes that also reported data on ‘student achievement or another learning outcome’ (p. 11). These learning outcomes had to be measured for ‘treatment and control groups’ and be ‘objective and direct’ (p. 12). Such measures included standardised tests or specific assessments related to learning outcomes. The effect sizes they wanted to examine related to contrasting f2f with online learning or blended learning, and they only counted studies that “provided enough data to compute an effect size” (p. 14). This meant they ended up with “51 independent effect sizes... abstracted from the study corpus of 46 studies” (p. 17). However, only 9 of the 176 studies related to the compulsory school sector (K-12), and it wasn’t clear how many of these ended up in the final 46 studies. Many of the studies appeared to relate to the health or tertiary learning sectors (see table of meta-analysis pp. 21-26), and tested specific, definable outcomes. In the end, this meta-analysis, focused as it was on comparisons between different types of online/blended learning, concluded two things of interest for the compulsory school sector. Firstly, that

Studies in which the online learners worked with digital resources with little or no teacher guidance were coded here as “independent/active,” and this category was the one learner experience category for which the advantage of online learning failed to attain statistical significance at the $p < .05$ level or better (p. 53).

Secondly, that

Educators making decisions about online learning need rigorous research examining the effectiveness of online learning for different types of students and subject matter as well as studies of the relative effectiveness of different online learning practices (Means et al., 2009, p. 54).

The strong focus on empirical studies in this meta-analysis in the end precluded studies that otherwise might have informed the use of e-Learning in the K-12 sector. Finally, this meta-analysis showed that the actions of teachers in facilitating learning were crucial to learning outcomes, particularly when they concluded that “distance learning outcomes were less positive when instructor involvement was low... with effects becoming more positive as instructor involvement ... increased” (p. 53).

In terms of specific studies related to e-Learning tools, research literature has been dominated by work on interactive whiteboards (IWBs) in classrooms (Kent, 2004; Lewin et al., 2008; Somekh et al., 2007; Van Dusen, 2009), although it seems likely that tracking the educational uses of Web 2.0 affordances, mobiles and gaming will take over (Alexander, 2008; de Almeida Soares, 2008; Annetta, Minogue, Holmes, & Cheng, 2009; Assogba & Donath, 2009; Boling, Castek, Zawilinski, Barton, & Nierlich, 2008; Borau, Ullrich, Feng, & Shen, 2009; Cadogan, 2009; Chettle, 2009; Clyde, 2005; Corbett, Mace, & Regehr, n.d.; Cosh, Burns, & Daniel, 2008; Cristina, n.d.). Perhaps the focus on IWBs has occurred because they are easily observable in classrooms, or, because they are relatively expensive. IWBs are as frequently written about as computers, although there is a developing body of evidence of trials using tools such as iPods/iPhones (Learn 4 Life, 2009), and gaming technologies for learning (Annetta et al., 2009; Assogba & Donath, 2009; Blignaut & Nagel, 2009; Bonk, 2009; Burke & Rowsell, 2008; Burkett, 2008; Chen, Tan, Looi, Zhang, & Seow, 2008; Dale & Pymm, 2009).

One longitudinal study (Reisz, 2009) on the relationship between IWBs and learning concluded that IWBs were an ideal resource for those students whose motor skills prevent them from handwriting easily. The authors argued that for “those students whose attainment scores progressed over the two years” of the study (implying that not all students’ scores progressed), the key factor was the *skilled* teaching of concepts and numeracy and literacy skills to *small* groups of students, mediated by the IWB. Here, students were able to use the drag and drop functions of the technology to quickly become familiar with new learning, rather than be hampered with poor motor skills and handwriting. At the same time,

when teachers used the IWB regularly and deliberately, they greatly increased both the quality and the number of interactions with students. And, as IWBs became embedded in these teachers' practices, changes were documented. The authors noted that *small group* interactions with the IWB *over extended periods of time*, were most valuable to students' learning in these primary classrooms.

On the other hand, providing such extended periods of time to students may present an interesting challenge for secondary school teachers, as might centring attention on small groups for extended periods. The italicised words and phrases in the previous paragraph are key; they indicate some of the features considered important to the success of the reported studies, but which may be difficult in secondary school settings which are affected by school-wide timetables.

There is a noticeable prevalence in international studies on specific kinds of technological tools or hardware (for example, IWBs) rather than Web 2.0 tools currently used by many in social ways, such as Facebook and YouTube, or collaborative tools such as wikis blogs and cloud tools like GoogleDocs. On the other hand, there is a growing literature on, and experimentation with, mobile devices and their role in learning (for example, Hartnell-Young & Vetere, 2008; Keller, 2008; Nicholas & Ng, 2009; Rogers & Price, 2008; Spikol & Milrad, 2008).

Hartnell-Young and Vetere (2008) for example, examined the effects of mobiles in supporting the personalised learning of Aboriginal students in Australia's Northern Territories. They concluded that the mobiles helped students bring their cultural knowledge into the classroom, and noted the importance of teachers' actions in supporting this. Perhaps it also indicates changes in these teachers' pedagogies as they focused on the leverage the mobiles afforded their students' learning. It potentially also illustrates the desire of most teachers to hook into and use what motivates students to learn.

The SITES 2006 conference publication (Law, Pelgrum, & Plomp, 2008) outlined studies conducted in 22 countries. Conclusions from these studies suggested that:

- Computer access is a "necessary but not sufficient condition for ICT-use in learning and teaching" (Law, 2008, p. 275)
- Increasing access to computers per se doesn't bring about better learning experiences
- The way teachers create opportunities for learning with ICT matters.
- ICT adoption per se, doesn't bring about changes to teachers' pedagogical orientations; this needs to be deliberately fostered
- The impact on learners is "highly dependent" on the "pedagogical orientation" that teachers adopt vis a vis e-Learning (Law, 2008, p. 275).
- "Analyses of the data revealed correlations between lifelong-learning-oriented pedagogical uses of ICT in teaching and learning and perceived gains in students' 21st century outcomes. No significant correlations were found between traditionally oriented uses of ICT and students' learning outcomes, as reported by their teachers" (Law, 2008, p. 275).

These point to key messages emerging in other studies related to e-Learning: that teachers' pedagogical purposes and intentions while embedding any ICT in lessons is a critical factor in students' learning. As Alton-Lee's (2003) BES observed, motivation and engagement are necessary but not sufficient factors in academic achievement, they do however, link to a purposeful learning orientation. Access to ICT tools is important in a learning environment. But by themselves they are not sufficient: pedagogically wise use of ICT tools is critical if effective learning is to occur.

Keller (2008) considered how mobile technologies contributed to learning motivation, resonating with Hartnell-Young and Vetere's (2008) findings. Rogers and Price (2008) observed how mobile devices could support collaborative

inquiry in classrooms. Together, these studies suggest that these devices have the potential to enhance pedagogies embracing co-constructive and socially oriented practices (Twiss, 2008) along with critical thinking. These point to Key Competencies as outlined in *The New Zealand Curriculum* (NZC), especially regarding the necessary social competencies of ‘relating to others’, ‘participating and contributing’ and ‘managing self’. Furthermore, if we consider the focus on culture that Hartnell-Young and Vetere (2008) commented on in their study with Aboriginal students, then language, symbols and texts (as noted in the NZC) were an integral part of how these students brought their own knowledge to school and used it meaningfully. These ideas hint at key attributes associated with e-Learning affordances: motivation and engagement. These are two of the broad outcomes which appear to not only link to improving students’ academic achievement over time, but also support lifelong learning attitudes. These factors are iterated in the PISA findings (OECD, 2005).

The importance of authentic audiences for learning was the subject of Nicholas and Ng’s (2009) work. They reported on the value of Internet technologies to extend the capabilities of a group of gifted learners attending a four-day ‘Sun, Science and Society’ camp. The study investigated the extent to which online technologies (an online management system, e-mail, and Web-based resources) supported further learning for these students 6 months beyond the camp. This virtual community consisted of like-minded students and familiar facilitators. Nicholas and Ng discovered that the students’ engagement and motivation (key elements of the NZC Key Competency ‘managing self’) was highly variable. This, they surmised, related to the students’ perceptions of a viable audience who would share and critique ideas. An additional point to consider might relate to the degree to which the virtual community was facilitated through good pedagogical practices.

The notion of audience is significant, since it points to an underlying learning motivation for students, and suggests that e-Learning affordances may make finding and keeping authentic audiences much easier than it has ever been. Pt England School’s students and staff have already discovered the benefits of authentic audiences through their regular podcasts to the world through KPETV (Burt, 2007).

In terms of examining Web 2.0 tools, social networking and blogging have been examined as follows. In 2008, Luehmann reviewed the way teachers used blogs to develop their professional identities, while Luckin, Clark, Graber, Logan, Mee and Oliver surveyed 27 UK schools’ students’ use of Web 2.0 activities. They concluded that while there was prolific use of these tools, the patterns of use led the researchers to categorise four types of behaviours:

- Researchers: reading, but little critical enquiry or analytical awareness of these texts
- Collaborators: these shared files, used Web 2.0 for gaming and communicating
- Producers: constructed artifacts using ICT tools (including mashing and modding), and usually published
- Publishers: shared their experiences or artifacts through social networking sites.

Essentially, the authors concluded that while many students used these Web 2.0 tools in some way, few used them critically or metacognitively, thus they argued that these higher order thinking processes needed to be deliberately nurtured by teachers so they could be used to their fullest extent.

Grant (2009) used a case study method to examine the use of a wiki in a secondary school. This study identified tensions between collaborative and learner-driven learning with students’ views of learning; some may resist collaborative processes. Grant argued that a teacher’s educative purposes and facilitation are key to the successful use of such processes and tools. These ideas resonate with Mark Callagher’s use of GoogleDocs in a New Zealand senior history class, where, tracked in his blog, he makes explicit the kinds of thinking he’s aiming for, exemplifying both sound pedagogical practices, and some of the potential of Web 2.0 tools (see *High School e-Learning* at <http://markcallagher.com/>).

Social networking sites were the area of interest for Greenhow and Robelia (2009) who explored the role such sites might have in developing 21st century technological fluency and becoming contexts for learning. They focused attention on poor students' use of these spaces, which they found became places for developing their identities and engaging with 21st century skills. They also found that these same students did not necessarily make any connection between these activities and classroom learning. This suggests the importance of teachers showing students how to successfully use these tools educationally. Selwyn's (2009) critique of university students' educationally-linked uses of sites such as Facebook and MySpace concluded that they tended to critique learning experiences, share the logistics of tasks and assessment requirements, and provide emotional support. So, while these uses are not necessarily about improving content or conceptual knowledge, these sites are a means by which students can connect about the identity issues related to being students together. They can thus be seen as a partial steam vent, and a way to articulate feelings and responses to learning contexts and experiences.

The current body of international evidence suggests that learning can be enhanced by judicious use of various technologies in conjunction with pedagogical practices that engage students in problem-solving and co-operative, active learning. Technology-rich learning environments can positively affect students' engagement with learning (OECD, 2005). Relevant pedagogies will be explored later in this review. New Zealand evidence as found in articles and theses is attended to next.

National evidence

- Many young people are technologically literate regarding social networking and using mobile technologies as everyday tools, but they may still be neophytes when it comes to understanding how to use them in purposeful and educationally oriented ways.
- Learning in an e-Learning-rich environment may make peer and collaborative learning opportunities easier, thus supporting students' cognitive, affective and social interactions. These ways of learning also appear to suit many New Zealand students, especially Maori and Pasifika (Ako Aotearoa, 2008; Franken, May, & McComish, 2005). These ways of working may lead to improved educational outcomes.
- The prevalence of e-Learning technologies in some schools as natural ways of working point to ways in which traditional learning (literacy, numeracy) can be achieved in highly motivating ways.

In terms of New Zealand evidence, Ministry of Education and other commissioned reports, plus theses, books and journal articles were searched. Sources were selected that best fitted with both the parameters of the key research questions, and the search criteria noted earlier.

One place to start in examining New Zealand texts is Gilbert's (2005) work exploring what knowledge creation might mean in the 21st century. She made the point that knowledge can now be found almost anywhere by anyone, and at any time. Now that the Internet is increasingly available through Wifi and on mobile devices, this has never been truer. This ubiquity (ie any time, any place) challenges traditional sources of knowledge, and may be a key to understanding why studies examining e-Learning in classrooms consistently report on how it precipitates changes to teachers practices, and highlights students' preferred ways of learning. These can change the dynamics in classrooms from situations in which the teacher is the knower and controller of the learning, to situations where students are more in control and have greater responsibility. This may be because students are more comfortable users of technological social networks and affordances than their teachers, and they can access, manipulate and navigate information sources almost at will (given effective and efficient Internet/Wifi connections).

There is a caution however, for while many young people are technologically literate regarding social networking and using mobile technologies as everyday tools, they may still be neophytes when it comes to understanding how to use them in purposeful and educationally oriented ways. So, it is not always true that young people are as digitally native as some theorists would have us think (Prensky, 2001a). They still need the guidance effective pedagogy brings to learning new concepts and content. If the two can be harnessed via enabling technologies (for example, mobiles, gaming principles), then there is the possibility that learning in schools will become truly engaging for 21st century learners from increasingly diverse backgrounds (Alton-Lee, 2003; Ako Aotearoa, 2008; Ministry of Education, 2008). A clear trend in twenty-first century learning is the strength of its collaborative and networked nature. These factors may enhance both the cultural behaviours of Maori and Pasifika students in New Zealand classrooms in particular, and the general social and learning of behaviours of students in general. They may also link to the practices Bishop and Berryman (2006) advocate in supporting effective learning for Maori. In terms of Pasifika students, teachers who cared about individual students and worked to provide learning contexts that supported diversity, were more likely to help Pasifika students succeed (Franken et al., 2005). Technology-rich coupled with co-constructive classroom practices are likely to help in this regard, as the PISA (OECD, 2005) report indicated when it suggested that such classrooms promote increasing collaboration and a more dynamic relationship between students and teachers.

In terms of *teachers* developing their competence with digital technology, a longitudinal six-year study on the value of laptops for teachers in New Zealand schools concluded that laptops made a difference to teachers' expertise in ICT (Cowie et al., 2008). Over time, this initiative and the national ICTPD programme led to a gradual incorporation of e-Learning processes and tools into classroom practices beyond administrative convenience (Cowie et al., 2008; Ham, 2008).

A key benefit for teachers with a laptop was its portability – they could use the same piece of hardware at home as well as in the classroom, in meetings, and readily share resources and ideas with colleagues, making them flexible almost mobile technologies. A lasting benefit, according to Cowie et al. (2008), is the streamlining of administration for routine tasks such as report writing, attendance and attainment records, and checking timetables.

Key learning/teaching benefits for those with laptops included the easier access to online resources, quicker preparation and drafting of resources and lessons. Essentially, the Cowie et al. report found that “the increased access to a wide range of information, resources and people had changed the way learning resources were defined” (p. 3). An interesting development when teachers used their laptops in classrooms, was their reporting that students made “gains in understanding and interest” when they used “multi-modal lesson materials” (p. 3). The study's authors also observed that, “the patterns of interaction in their classrooms had changed with them [ie the teachers] taking a more facilitative role” (Cowie et al., 2008, p. 3).

This finding suggests that teachers with ready access to e-Learning technologies are better positioned to develop more harmonious, focused and student-centred learning environments than they might otherwise, leading to teachers adopting more inclusive pedagogical practices that in the end create better learning environments for students and better relationships with them. Cowie et al. point to some important outcomes both for students and teachers, especially in relation to students' positive orientations to learning and teachers' confidence and competence with ICT tools. All of these appear to be preconditions to successful learning and achievement outcomes.

A consistent message in national (and international) reports is the pivotal role of the teacher in supporting learning with or without the aid of e-Learning tools (such as Alton-Lee, 2003; Claro, 2007; Cowie et al., 2008; Ham, 2008; Ministry of Education, 2002, 2006; Somekh et al., 2007; Tearle, 2004). For instance, the e-Learning Action Plan asserts that effective teaching depends on teachers “becoming confident and capable users of ICT and understanding how to integrate ICT effectively into their teaching practice” (Ministry of Education, 2006, p. 10). It goes on to argue that

without teachers, it is unlikely that students can achieve “desired” learning outcomes. According to the same report, one way of achieving that aim is through teachers constantly evaluating both the “appropriateness and effectiveness of available technologies and digital resources” (p. 10), and their pedagogical decisions about when and how to use them with students.

The focus on the role of the teacher doesn’t end there. Nussbaum et al., (2009) explored what it took to create collaborative and student-centred classrooms using ICT in classrooms (both primary and secondary) in the UK and Chile over the period of one month. They concluded that a teacher’s ability to scaffold that learning was critical to students developing the skills to engage in effective, “knowledge-building” (Nussbaum et al., 2009, p. 153) group learning discussions using specific ICT tools (both hardware and software). The New Zealand Ministry of Education’s (2006) report suggests that similar student-centred pedagogies are central to embedding ICT tools as natural parts of classrooms, and links to the findings raised in the Cowie et al. report, Falloon’s (2004) doctoral thesis, and other international studies (such as Hayes, 2007; Kim, Park, & Baek, 2009; Lim & Hang, 2003). The evidence is mounting that teachers are critical to good learning, regardless of whether or not e-Learning tools are integral features in these classrooms.

Falloon’s doctoral thesis, for example, explored how primary school students learned in one e-classroom. He concluded that learning in such an environment made peer and collaborative learning opportunities easier, thus supporting students’ cognitive, affective and social interactions. In this classroom, the teacher reported that students appeared to be more focused and engaged in learning than they had been previously. In turn, this helped the teacher facilitate more student-centred approaches, and enhanced her own satisfaction because students appeared to be enjoying their learning.

Engaging in learning is important whether in primary or secondary schools. Bolstad and Gilbert (2006) examined the value of the Tech Angels project in a New Zealand secondary school, where students took on the role of supporting teachers’ and other students’ knowledge of ICT tools. The school leaders’ ultimate aim was to introduce new ideas about teaching and learning with ICT tools to support a shift *away* from teacher-centred, “old” knowledge-based approaches, to student-centred, “new” knowledge-based approaches. While this project provided authentic ICT learning experiences for the Tech Angel students, teachers did not necessarily make the link between their use of ICT tools and changes to their own pedagogical practices. Even while these teachers observed that it built students’ self-confidence, positive relationships, leadership skills, and problem-solving (skills noted as important in the NZC’s Key Competencies, Values and Principles), they did not see that this was also true of their own development vis a vis the technological tools. The opportunities for learning were there, but not the spaces in which teachers could evaluate what had gone on in terms of their own professional learning. In this Tech Angels project, ICT tools afforded students opportunities to connect with real-world problems in authentic contexts using information, engaging with new concepts, subjects and issues as part of a wider network of learners, and developing leadership skills and expertise at the same time.

There is, as the Bolstad and Gilbert study showed, potential for leadership to develop in the e-Learning arena at many levels in schools; but it needs to be deliberate and involve reflective opportunities at all levels. Forbes (2004) indicated at least three obligations relating to leaders and e-Learning: to emphasise inquiry and research into such learning affordances; to create opportunities for learners; and to invite collaboration with other learning communities in order to foster an inquiry, feedback and improvement cycle. So, even though this study considered e-Learning leadership in a tertiary institution, these same principles are relevant for school staff, in both primary and secondary contexts. This is because in order to improve e-Learning outcomes in schools, effective leadership in e-Learning needs developing in a cohesive and deliberate manner. The NZC focus on teaching as inquiry as being related to effective pedagogy may be of use in this regard (Ministry of Education, 2007, pp. 34-35). Interestingly, Forbes also asserted the value of constructivist learning as being integral to such leadership.

Where e-Learning is discussed, some specific pedagogies are emphasised more than others. This segues into the next section of the review, which discusses pedagogy and e-Learning.

Pedagogy and e-Learning

- e-Learning and collaborative/co-constructive pedagogies go together.
- The dynamics of classrooms change when e-Learning is part of the regular learning environment.
- Using collaborative, interactive pedagogies that also foster co-operation, appear to lead to effective learning and better teacher/student relationships over time.
- Technology in classrooms becomes an effective tool when teachers deliberately use them in relation to appropriate and targeted pedagogical practices.
- Preventing access in schools to mobile technologies or firewalling some sites does not teach effective and critical uses of these technologies that students have ready access to outside of school.
- Virtual worlds and gaming have potential in compulsory education. They are already used widely in medicine and aviation and other tertiary learning environments, and are increasingly being used in business as part of research and development, as well as employee induction.

In any focus on classrooms, what teachers do has an impact on how well-disposed students are to learning. For instance, “Teachers’ classroom motivating practice includes both their design of the classroom learning environment, and their direct, interpersonal relationships with individual students” (Hardré & Sullivan, 2009, p. 2). The physical spaces of the classroom and what happens in them are influenced by the arrangements within them: it is teachers who organise these spaces, resources, and opportunities for learning. This is important to consider when the “emphasis today is on active construction of knowledge by the learner” (Chism, 2006, p. 2.4). This implies educationally productive levels of interactivity – both among peers and with teachers, and links closely to the kinds of pedagogies Bishop and Berryman (2006) suggest support Maori students’ learning, and which are foregrounded in *Ka Hikitia* (Ministry of Education, 2008).

The United States meta-analysis on online learning (Means et al., 2009), identified three ways in which learning experiences occur with e-Learning tools/affordances:

- Expository instruction—where digital devices transmit knowledge, much as f2f lectures do.
- Active learning—where learners build knowledge through the inquiry-based manipulation of digital artifacts such as online drills, simulations, games, or microworlds.
- Interactive learning—where learners build knowledge through inquiry-based collaborative interaction with other learners and where teachers can become co-learners and act as facilitators (p. 3).

A teacher’s orientation to pedagogy is thus critical to learning; effective e-Learning opportunities do not happen without a teacher’s deliberate pedagogical actions. These opportunities create spaces for interaction, collaboration and thinking to occur in educative ways, using e-Learning tools and affordances in authentic ways. Nussbaum et al. (2009) assert that while collaboration or the active construction of knowledge between learners can enhance outcomes, this is not necessarily spontaneous; it must be learned. In other words,

teaching learners how to collaborate, and in particular how to work together to negotiate meaning, is a necessary part of the process of learning collaboratively which can enhance outcomes further.
(Nussbaum et al., 2009, p. 147)

This relates to structuring learning so that students can apply the familiar (prior knowledge) to the unknown, in order to create new understanding. Chism (2006) makes the point that students are most likely to learn well when their senses are stimulated, when the exchange of information is encouraged, and there are opportunities for rehearsal, feedback, application, and transfer. Alexander (2001), although referring to tertiary teaching, asserts that a teacher's conception of learning has a "major influence" (p. 241) on course planning, pedagogical actions, and what and how students learn. Alexander also notes that students' experiences are a "direct result of the particular combination of factors which make up the e-Learning system" (p. 242).

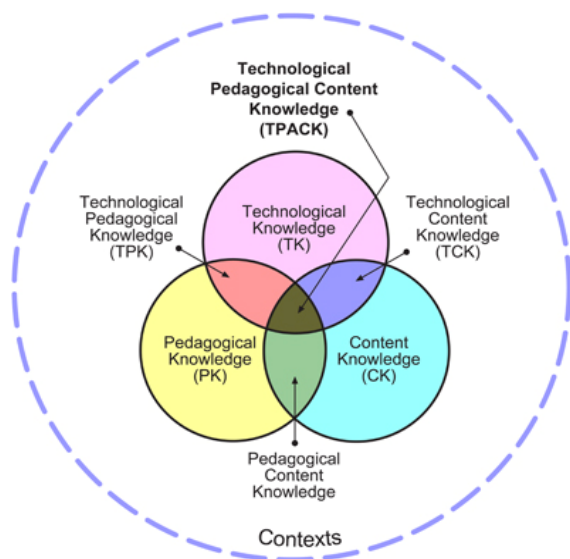
In examining literature on e-Learning and outcomes in refereed journals, there were clear demarcations in the research foci. A large number of texts were situated e-Learning in tertiary contexts, and for the most part, these were discarded because they fell outside the schooling sector focus. Three broad categories were used to sort the rest: *about, with, or through* ICT/e-Learning. Those that were *about*, tended to describe what happened and how, with specific technology tools. These usually focused on learning about ICT tools and their application in specific contexts and circumstances. Computer studies inquiries most often fell into this category, as did articles detailing findings in using specific hardware or software applications. One article in particular examined why so few girls entered tertiary studies in ICT areas, and so looked to secondary schools for answers. It concluded that there was a downward trend in students participating in these school subjects, proposing that emphasising understanding the programs themselves, rather integrating them into dynamic and authentic uses, could be putting students, and particular, female students, off (Reid, 2009). The gender trends in e-Learning are not discussed in any detail in this review.

This suggestion links both to teachers' pedagogical purposes and what appears to be a strong desire in 21st century students to learn collaboratively and socially, mirroring their experiences of what social networking affords them. In these kinds of learning environments, students rather than teachers are at the centre of the learning experience. In order for students to learn in such student-centred contexts, the teachers' role is to facilitate the opportunities, using appropriate pedagogical processes and e-Learning affordances. These affordances should be fit for purpose: they support specific subject skills, concepts and content needs, and allow students the means by which they can develop their knowledge through trial and error (see discussion of gaming principles later).

A key place to start is Mishra and Koehler's (2006) exploration of technology in relation to content knowledge and pedagogical knowledge. They assert that technology has always been related to education, but the key aspect is always the intersection among these elements; pedagogical actions are key to successful technology use in classrooms. Their diagram succinctly encapsulates this intersection, and identifies the teacher's place as being at the epicentre of it (see http://www.tpck.org/tpck/index.php?title=Main_Page)

Another example of 'about' is Ballantyne's (2004) thesis found that teachers needed to alter their pedagogical practices to better adjust to students using technological tools regularly in classes, through purposefully reformulating the use of the technology for learning.

On the other hand, Stevenson (2008) observed that a group of senior students in physical education who also used Web 2.0 tools developed the kinds of personal competencies endorsed by the Key Competencies in the NZC. She noted that teachers' pedagogies adapted from relatively "authoritarian approaches" to more collaborative ones during the learning process with these tools. In other words, teachers began to work more *with* students in facilitative ways. In this scenario, students developed greater independence from their teachers and related better to each other while still completing the

Figure 2: TPCK Mishra and Koehler (2006)

required coursework. A significant factor in this process however, was the presence of online mentors. This guided support reinforces two things: the relevance of student-centred approaches that encourage students becoming independent learners, and the importance of facilitative pedagogical practices that work with the technology to advantage the learning. There is also a third implication: that these more personalised methods and interactions made it easier for students to engage conceptually with new learning. This more personal process links to the findings of Somekh et al. (2007).

Other studies featuring ‘about’ orientations focused on technological tools rather than on how they led to effective learning outcomes. Such studies include Sprague and Pixley’s (2008) description of podcasts. This paper explained what podcasts are, how to make them, and some of their educational

uses. The article referred to some teacher-created podcasts designed as either a “just-in-time support” (p. 231) for students’ homework activities, or as a repository of information for revision. What is of interest here however, is the authors’ assertion that the “real power of podcasts, as with any technology, is when it is placed in the hands of the students... it allows students to work on a project that is meaningful and motivating” (p. 231). The ‘meaningful and motivating’ aspect should link to pedagogical and learning outcomes that tools like podcasting can make more accessible. Assertions which do not fathom the concepts being practised or understood through the making of the podcasts, potentially position ICT tools as educational silver bullets, rather than opportunities for teachers to provide student-centred learning opportunities. However, these tools are of most benefit when they help students learn *other things* because they operate as a student’s means of transport, not a destination. ICT tools provide access to information and can lead to a focus on higher level cognitive processes more quickly because they can make it easier to complete more mechanical processes that no longer require fine motor skills to complete, such as writing, drafting, or numerical calculations. The ways in which Pt England School has used podcasting as a means by which students develop their metacognitive, literacy and numeracy skills is a case in point. Another is the Lewin, Somekh, and Steadman, (2008) IWB study, where students could easily use drag and drop functions to explore their learning.

Convery (2009) unmask the broad lack of evidence for claims about the learning effects of specific technologies and Mitchell, Bailey and Monroe (2007) acutely observe that, “Initial student excitement, if any, at an innovative technological approach may quickly fade when technology is the expected “normal use” from their [the students’] perspective” (p. 78). These ideas suggest that the excitement of the newness of incorporating ICT tools may create a level of student engagement not necessarily obvious before. But as these practices and tools become normalised, the Hawthorne Effect may wear off, and engagement levels or improvement levels may restabilise. This points to the importance of teachers considering long-term effects of incorporating ICT in classrooms, and finding ways of using such tools for authentic purposes. Similarly, if the new tools simply replace an old one (such as presentation software instead of overhead transparencies) with little else changing, then student engagement and interest will quickly revert to previous levels because nothing has essentially changed *for the learners*. They may suffer from the equivalent of ‘death by PowerPoint’.

Alex Katerev’s site¹ explores the notion of ‘death by PowerPoint’, and while his view is focused on business contexts, the audience effect is valid for educational contexts. If teachers are not alert to the potential opportunities to interact

¹ (<http://www.slideshare.net/thecroaker/death-by-powerpoint>)

differently with their students through using ICT, very little will alter for students' learning outcomes; students can become bored by teachers talking too much with the aid of slideshows because they remain passive recipients of information. This passive receptivity role is an enduring issue, especially in some secondary classrooms. A key issue for some teachers, therefore, is the extent to which they are prepared to alter their pedagogical practices to better suit many students' preferences for interactive, collaborative problem-solving ways of learning, especially when these teachers' preferred pedagogy may be teacher-centric, and oriented to content and classroom control.

Moos and Azevedo (2009), in their recent literature review on computer-based learning environments and self-efficacy, noted that students who use metacognitive strategies and processes (that is, activating their prior knowledge, and deliberately managing their developing understanding of new concepts and processes) when using e-Learning tools, tended to be more effective in developing deeper understanding than peers who failed to use such strategies/processes as effectively (see also Wan et al., 2008). This level of active participation is linked to their motivation for learning. How well can students navigate, search, select and transfer information for learning purposes, and what do they need to know to make this a natural process? The competence of learners to do this – to navigate new concepts and contexts – is partly down to what teachers do. Wan et al. (2008) examined the psychological processes that link prior experience to learning outcomes via students' "virtual competence" (p. 513). They asserted that there were two important aspects to consider: the first is pedagogical design, which is important to fostering a positive ICT experience. The second aspect is the level of students' existing prior knowledge and virtual competence. Bridging or filling in the gaps is where teachers have a crucial part to play.

Motivation, as Moos and Azevedo point out, is understood to relate to constructs such as persistence, effort, and some behavioural activities, and these link to self-efficacy. Students with high self-efficacy will "persist in the face of difficulty" because they have the metacognitive skills to call on when needed (Moos & Azevedo, 2009, p. 578). This eventually affects academic performance. As indicated earlier, teachers can make a difference to students' self-efficacy by helping them develop metacognitive skills through deliberate acts of pedagogy centred on critical literacies (addressed later), and using e-Learning technologies to provide the motivation. Motivation is also linked to students' metacognition; students who use common features of computer-based tools, such as cross linking (for example, through using hyperlinks), compared with the kinds of linear reading processes more commonly associated with print texts, appear to demonstrate higher learning gains (Moos & Azevedo, 2009). If this is so, then there is a link between student-centred pedagogies, metacognitive and literacy approaches to learning, and e-Learning affordances.

Few of the works describing learning *with* ICT tools addressed the impact on students or considered outcomes of any description. In many of these articles/documents, it was like reading about getting caught in the headlights- the bright and shiny object was a thing of wonder, but there was little exploration of the effects beyond the novelty of the occasion, which could instead be attributed to the Hawthorne Effect. This Effect refers essentially to what occurs in a given context when any explicit scrutiny or measurement takes place: positive (or negative) effects can occur through the introduction of something new to an environment, but there is no certainty of any lasting change beyond the intervention, measurement, or observation period. The very act of observing, questioning or evaluating something can alter it; scrutiny can heighten the awareness of those being observed or measured.

One example of this in action is documented by Mitchell et al. (2007), for instance, described what it was like for a mature, able teacher to adjust to three things: new pedagogical processes, a standards-based curriculum, and using ICT tools in geometry lessons. This teacher, guided by external university mentors, taught lines, angles and circles to 3 classes, using one of them as a 'control' group. This last group was taught using the methods the teacher was used to, while the other two were exposed to both different pedagogical practices and ICT tools and products. The teacher also had the support of a technologically savvy student teacher, plus the external experts. The teacher was nervous that altering his pedagogy and introducing ICT would limit the amount of geometry taught (the idea of e-Learning being on

top of content, rather than integrated with it). In other words, he thought that geometry would ‘lose out’. In fact, this was not the case, because a quantitative score showed that students from all three groups did well on the final teacher-made test. One wonders if the Hawthorne Effect was implicated here; both the students and teacher knew they were under scrutiny. The teacher, by re-thinking his role in the classroom and his pedagogical practices, may have been more aware of students’ learning needs than ever before, and more attuned to their needs, regardless of which class he taught. This may mean that his ‘control’ class, ostensibly taught in his usual way, could have been affected by the teacher’s heightened sensitivity to his pedagogy. The conditions for learning were also changed by the presence of other people in the classrooms. Thus, attributing outcomes specifically to the use of specific e-Learning technologies is a difficult claim to make. The following example further illuminates the Hawthorne Effect caution.

Studies in and about classrooms which use mobile technologies such as cell phones or other handheld devices, show that they can capture learning situations and objects as records for immediate or later review. This relates to mainly f2f (face-to-face) educational contexts in which learning opportunities are enhanced when teachers work closely with students using ICT tools (Burkett, 2008; Douglas & Kerr, 2010; Twiss, 2008). Convery (2009), in examining the educational environment surrounding a specific reported use of handheld devices in an art gallery visit of senior students from a UK school, concluded that:

the context of the students’ handheld use – the impressive environment, the supportive art gallery personnel, and the teacher’s preparatory and follow-up activities – were ... significant determinants on the success of the overall experience with the new technology. [The] initial conclusions were that using the PDAs without the gallery support staff or the teacher’s follow-up activities would have led to a much more limited learning experience. (p. 26)

This observation points to the critical importance of the pedagogical behaviour of the teacher, even taking into account the Hawthorne Effect.

When examining articles that report learning *through* ICT, the impact on learning or specific outcomes still isn’t especially clear. This is partially because attributing academic success to a specific e-Learning tool or method ignores the situated and complex nature of the learning environment, as has been alluded to earlier. It may be that a teacher’s pedagogical strategy led to an academic improvement rather than the use of specific ICT tools. Moos & Azevedo (2009) also cautioned about specific links between e-Learning tools and outcomes.

Students and e-Learning tools

Research by Lewin, Mavers and Somekh (2003) revealed a gap between home and school uses of technological tools for some students. Through interviewing students in case study schools, they discovered that there was an “extraordinary breadth of computer-based activities commonplace in many homes” (p. 45). These involved students in “extensive” use of the Internet and other media, to, among other things, access specialist knowledge relevant to their own interests, and create and use a wide range of software and hardware to make a range of products of their own devising. Lewin, Mavers and Somekh surmised that:

schools were generally failing to draw upon these transformative experiences of knowledge building in the home. Rather than technologies having any impact on transforming knowledge in the majority of schools, the traditional structures of curriculum and pedagogy were colonizing technologies and directing students’ energies in school to doing ‘more of the same more efficiently’. (2003, p. 45)

The comment about how schools were not capitalising on students’ proficiency with these tools at that time, would, we expect, have changed over time as teachers’ knowledge skills and capacities changed vis a vis ICT affordances. As Prensky (2006) rhetorically asked about digital immigrants and digital natives:

so is it that the Digital Natives can't pay attention, or that they choose not to? Often from the Natives' point of view their Digital Immigrant instructors make their education not worth paying attention to, compared to everything else they experience - "Every time I go to school I have to power down," complains one student - and then [instructors] blame them for not paying attention! And, more and more, the Digital Natives won't take it.

This idea of 'powering down' is reflected in some of the disaffections some students currently express about schooling. The idea of 'fun' in learning is not new, but what students actually mean by 'fun' is not widely understood. To many people hearing that word, it is assumed to mean that students want to be entertained, but to students themselves, it is about being able to engage in meaningful ways about what they're learning, with their peers. This is borne out by interviews with students conducted during fieldwork for the Secondary Schools Literacy Initiatives Pilot Project (2003-2005). During the evaluation of this project, students from schools throughout the country were interviewed and asked about their learning (Wright, May, Whitehead, Smyth, & Smyth, 2005). They consistently reported a desire to be able to work with peers, problem-solve and talk together about what they needed to learn. If e-Learning tools can assist with this kind of engagement then it is sensible to use them. After all, if we can accept that 'outcomes' can be interpreted widely, then engagement and involvement in learning would certainly qualify as both outcomes and 'fun', and show how using co-constructive pedagogies appear to bias for best. Again, these ideas link to the NZC's focus on connection and active involvement as 21st century citizens.

New Zealand teachers have already demonstrated what can happen when readily available technological tools (ie mobile phones) are used educationally (Douglas & Kerr, 2010). However, it is quite common for schools in New Zealand to ban cell phones and eschew many 21st century technological tools: some secondary schools for instance, have rudimentary, out-of-date or teacher-only access to such tools, including common ones like microwaves in food technology classrooms. Often this is in response to difficulties some schools have in financing replacements or updates, or dealing with issues of security or safe use. Where control of technology use is situated primarily with teachers, collaborative, co-constructive and student-centred pedagogies are unlikely to be enacted. In turn, this may restrict opportunities for students to practise Key Competencies.

Smyth and Hattam (2004), in their study of over 200 early school leavers in Australia, describe one boy's experience. He left school early to fully develop a business related to computer programming he had established while at school. Because these skills were not noticed or enhanced at school, this boy made a conscious decision to pursue his more relevant interests. Gilbert (2005) prefaces her exploration of the knowledge society by describing how some school students developed online identities, expert in fields not catered for by their schools. These examples point to ways in which some students find niches in online or other technological environments that both circumvent what schools currently have to offer, and provide stimuli for learning beyond the classroom. While these may not be common at present, they indicate something of the potential. As technologies become increasing sites for collaboration, community and identity, such examples may increase substantially. Thus, teachers' beliefs and knowledge about the affordances of digital technologies identifies a relationship between the depth of students' engagement in school learning experiences, and their retention at school, because of a mismatch between students' non-school lives and school.

A doctoral thesis carried out in Thailand (Rumpagaporn, 2007) in a variety of schools argued that students, particularly in secondary schools, improved their academic performances through peer-to-peer interactions afforded by ICT tools. By comparing their work and linking themselves to their peers through these shared online interactions, students were able to improve their learning, implying that these students engaged in deeper thinking because they could be more deliberate and reflective in their online conversations. The study also found that the participating secondary school students preferred to work in groups while using these tools, and ended up with better relationships with their teachers. These small group alliances echo the small group effects and processes highlighted in Somekh et al.'s (2007) work.

These secondary students in Rumpagaporn's study were also more competitive in their learning than the primary school students. Again, collaborative, interactive and student-centred pedagogies are identified as important in e-Learning classrooms.

The idea of students 'powering down' when they come to school (see earlier discussion related to Prensky) is also reflected in a recent conversation with the British academic Bridget Somekh (May 12, 2009), who revealed that while on sabbatical in New Zealand at the University of Canterbury, she visited a school which not only banned students' cell phones, but their laptops as well. This was the school's reaction to both the pressure of cyber bullying, and parents' expectations about the school's responsibility in dealing with theft or damage. Both of these issues took on greater significance than the potential of these devices as educational tools, and link to the struggles schools have in managing two different priorities related to e-Learning technologies. Forbes (Dianne Forbes, personal communication, June 19, 2009) pointed out that this issue can be likened to schools' responses to the dangers of water:

Restrictions and bans may keep children safe for a limited time, but do not enable or empower, and are rendered completely irrelevant once the 3pm buzzer goes. At the Netsafe conference I attended in Queenstown last year, the point was made time and time again, that we teach children to swim as well as putting fences around swimming pools; we teach them what to do if caught in a rip, and we supervise them as they learn. But we don't stop them from getting into the water. Banning swimming is unrealistic and short sighted, as is banning use of technology.

Gaming/virtual worlds and education

Bonk (2009) argues that gaming technologies are already part of learning, particularly in the tertiary sector, but also outlines uses in school subjects, such as writing (this links to character and setting development, as it does when creating avatars and island they inhabit in virtual worlds), history, geography, art geology, hard technologies (for example, automotive), social studies, environmental studies, journalism, and even languages.

In the tertiary sector, these technologies are commonly used in training pilots in flight simulators, and in medicine to develop surgeons' skills: "medical and aviation simulators...can build the hand-eye co-ordination needed to increase effectiveness in surgery or in an air emergency. Skills for minimally invasive surgery, such as laparoscopic surgery, can be honed through playing video games" (p. 276). He also points out that, "...virtual worlds, games, and simulations exist from real-life situations to augmented and virtual reality" (p. 276) and so the scope for their application to the compulsory years of schooling exists now.

Virtual worlds like Second Life are already part of many employees of organisations like IBM. As Bonk (2009) outlines, this company, by 2007, had "expanded its presence in Second Life to some fifty virtual facilities used for research, company meetings, and recruitment and induction of new employees" (p. 279). IBM uses Second Life to simulate project management and customer interactions, which help employees develop skills they might otherwise not have. At the same time, it saves the company money. Universities like Harvard, Stanford and MIT in the United States have also forayed into this virtual world to add to instructional methods and modes, and incorporate Web 2.0 affordances that provided students with learning options that effectively deepened learning experiences (Bonk, 2009).

In a different investigation of the use of gaming technology for specific educational purposes, Jackson (2009) observed that it has the potential to provide students with options for learning challenges that mimic the zone of proximal development Vygotsky (1978) advocated. In gaming, students "learn to set and manage short-term and long-term goals" (Jackson, 2009, p. 292), and also learn by doing, problem-solve and construct their own understandings as they go. Jackson argues that through such processes, "videogames rely on constructivism, the idea that learners build their own knowledge structures" (p. 292). At the same time, gamers are risk-takers; they can make multiple attempts to improve, building knowledge and competence as they go. Feedback is often instantaneous. It may be humorous or deadly, but

encourages the learner to persist. Feedback from teachers is not always received the same way, but as personal judgement. Mistakes in gaming, partly because it is removed from the real world, are seen as learning opportunities, allowing gamers to engage deeply (Gee, 2003; Prenksy, 2001b) in what Csikszentmihalyi (1990) calls 'flow'. This also highlights Bonk's (2009) discussion about the potential for virtual worlds to deepen a learning experience. Squire (2008) suggests that

Surveys of gamers show that they have an increased appetite for risk, a greater comfort with failure, a stronger desire for social affiliations, a preference for challenges, a capacity for independent problem solving, and a desire to be involved in meaningful work when compared with nongamers. (p. 658)

If this is so, then what implications does this have for educators? Jackson, in reviewing her pre-service teacher education classes and trialling game-based learning with her students, concluded that

If someone guides you every step of the way when you are in unfamiliar territory, you will not remember your path. The information enters short-term memory but then leaves before being transferred to long-term memory. On the other hand, when you have to figure it out yourself, similar to videogames, you engage in the deeper processing that commits the information to long-term, or at least longer-term, memory. (Jackson, 2009, p. 295)

And while she was focusing on adult learners entering education as a profession, her framework is equally applicable because the pedagogy is foregrounded. The premise outlined in the quote can be understood if we think that 'mistakes' can become 'learning opportunities' or there's the opportunity to have multiple attempts at something in order to improve. This may be likened to learning a ball skill. Catching may take some time to perfect, but students are never given only one opportunity to catch a ball. It needs to be caught several times, from lots of angles before a new skill is added to the mix. Jackson listed specific outcomes from both interviews, course evaluations and unsolicited student remarks. Essentially, she concluded that the game-based teaching "outscored direct instruction" (p. 300). It also combined problem-solving, learning about technology, and learning by doing coupled with evaluation.

Wikis and 'through' ICT

An interesting study about learning *through* ICT was reported by Heafner and Friedman (2008). They discussed secondary school students engaging in Wiki creation in a social studies class, and the consequent effects eight months later when they conducted interviews with the same students. Students were evaluated in terms of their levels of engagement in the wiki, the demonstrated cognitive benefits of this engagement, and overall learning in both the short and long term. The authors reported that the Wikis facilitated a "pedagogical shift from traditional teacher-centred instructional approaches to student-oriented, constructivist learning". They also claimed that the Wikis contributed to student self-efficacy and motivation, which links to the findings in the Moos and Azevedo (2009) review. In the later interviews, Heafner and Friedman found that students who had created Wikis showed greater content retention and understanding than their peers who had learned the same content through traditional teacher-centred instruction. The authors concluded that the long-term cognitive value of the Wikis helped students to develop a deeper understanding of content through being able to both visualise the chronology of events in the topic and cause and effect relationships. By being able to add to and revise the information in the Wiki, these students actively created their knowledge in a shared and relatively public way. Such findings highlight contradictions between the individual and user-centred orientation of digital technologies and Web 2.0 affordances, and the increased capacity to belong to collectives through social networking, Wikis and blogs. It also links to the trial and error processes prevalent in gaming as mentioned earlier.

Learning 'through' computers in a primary setting

In a Finnish primary school, where the teacher provided 9 computers for student use (Teachers TV, 2006), the teacher discussed the difference this access made to her pedagogy over time. She reported that she no longer saw herself as the

expert and controller of knowledge, but was, instead, the organiser of opportunities for students to engage in guided discovery. Students, she said, moved around the classroom more, and helped each other to learn and share what they discovered. This democratisation of the classroom appears to be a feature of 21st century e-Learning tools, demonstrating that “The considered use of ICT can transform the teacher role, creating new learning environments” (Ministerial Council on Education, Employment, Training and Youth Affairs (Australia and New Zealand), 2005, p. 3) (Note: this organisation is most commonly referred to as MCEETYA).

On the other hand, the Canadian Council on Learning’s recent report (Abrami et al., 2008) argued that e-Learning might create an “imbalance between the development of computer skills and the fostering of essential academic and thinking skills” (p. 62). This view suggests that e-Learning might exacerbate isolation and technological dependence. It also implies that e-Learning may compromise content by being additional to, rather than integral with, subject learning; a fear the geometry teacher had (Mitchell et al., 2007). However, this argument runs counter to prevailing findings and assumptions about e-Learning – that it fosters collaboration, interaction, networks and community as well as making it easy for people to create, modify and change what appears on the Internet (mashing and modding). Wikipedia, YouTube, Podcasts and blogs have made it possible for anyone to connect to and collaborate with, a worldwide audience. As has been noted earlier, an authentic audience is a powerful motivation for school students.

It’s not only students who gain motivation for using e-Learning tools. Teachers embracing e-Learning technologies report positive changes to their pedagogy (Alexander, 2008; Alexander, 2001; Ballantyne, 2004; L. M. Mitchell, 2007). They report becoming more focused on student-centred, active and interactive learning and connected more closely to students’ prior knowledge and experiences. At the same time, they provided opportunities for students to create, communicate, construct and transform knowledge through regularly using e-Learning affordances. Through these means, it is likely that critical thinking approaches to learning are common rather than exceptional pedagogical practices (MCEETYA, 2005).

Finally, as Mishra (2009) clearly pointed out, “if you’re not going to change pedagogy, then technology use makes no significant difference”. Basically, he asserted that increasing technology per se did not lead to student learning, but its effectiveness was entirely dependent on the teaching approaches used *in conjunction* with it. After all, he says, “teaching is about the transformation of content for learning to think in a disciplined manner” and it is about ‘transforming disciplinary knowledge to meet the needs of students’. That’s where the critical role of the teacher comes in, because in order to help students to ‘see’ in a disciplinary manner, careful, deliberate, spiral and recursive practices must take place if students are to access this new thinking. And this leads to a consideration of the role of critical thinking, metacognition, and multiliteracies.

Critical thinking, metacognition and multiliteracies

- Critical thinking is related to multiliteracies. It is the development of the facility to understand aspects of texts such as agency, motivation, gaps and silences, and political and economic agendas. It is also about purposeful and reflective judgement, involving determining meaning and significance of phenomena, including different kinds of texts. This deliberate critical stance is as important to e-Learning texts as it is to the critique of traditional texts, because it is about higher order thinking skills: Thinking is a Key Competency in NZC.
- Pedagogies that feature collaboration and problem-solving tend to involve students in higher order thinking, and support them to retain learning long after they first meet new content and concepts. Through such practices, students are encouraged to talk, pose questions, take risks, experiment, reflect and share ideas.
- ‘Multiliteracies’ is a term coined by the New London Group in order to describe what constitutes literacy in the 21st century. The term acknowledges the idea of textual multiplicity. This idea encompasses the technological explosion of what constitutes a text, and considers this in relation to cultural and linguistic diversity and what it means to be literate. Another facet of this definition refers to the agency of making meaning: that this can be a critical factor in social change.

Aspects of critical thinking have already been alluded to in this review especially regarding metacognition and the ability of students to navigate and manipulate electronic texts to develop conceptual understanding. Critical thinking is also related to multiliteracies: it is the development of the ability to understand aspects of texts such as agency, motivation, gaps and silences, and political and economic agendas. It is also about purposeful and reflective judgement, involving determining meaning and significance of phenomena, including different kinds of texts. This deliberate critical stance is as important to e-Learning texts as it is to the critique of traditional texts, because it is about higher order thinking skills: Thinking is a Key Competency in NZC.

Wan et al. (2008) for instance, considered the importance of students’ virtual competence in learning. They defined ‘virtual competence’ as an individual’s ability to leverage virtual settings to their maximum potential. This ability to use such leverage can be understood as a critical thinking capacity. A teacher’s role is to harness these skills educatively, so that students develop greater independence as learners and can function as thoughtful citizens.

Rumpagaporn’s (2007) thesis identified the value of ICT tools in classrooms to outcomes of critical thinking and positive attitudes to e-Learning. Data from this research, using both qualitative and quantitative means, led to the view that overall, many students improved their levels of critical thinking during the course of the research. Critical thinking was, for the purposes of this study, defined as consisting of not only three essential processes (problem-solving, a reasoning and decision-making) but also the ability to be self-reflective and willing to critique others’ thinking. The *Thinking Key Competency in The New Zealand Curriculum* links to this definition, since it identifies “using creative, critical and metacognitive process to make sense of information, experiences and ideas” (2007, p. 12) as important components of this competency. Thus, any tools which help students develop critical thinking capacity, are worth experimenting with in classrooms.

A doctoral thesis conducted in Queensland senior physics and junior science classrooms identified the impact of using web-based tools on students’ outcomes in these subjects (Chandra, 2004). Examining interaction and teachers’

pedagogical actions were key components of the study. Outcomes in this study specifically related to positive effects on academic performance as well as general attitudes to ICT. Interestingly, Chandra did not discern any differences between the performances and attitudes of girls or boys, but found that the senior physics students benefited most from using ICT as a problem-posing/problem-solving tool. It may be that this lack of differentiation between the performance of boys and girls could be attributed to their self-selection for physics, which may include a predisposition to problem-solving methods using tools at hand, but even so, problem-solving involves critical and analytical thinking.

Pedagogies that feature collaboration and problem-solving involve students in higher order thinking, and support them to retain learning long after they first meet new content and concepts. Higher order thinking includes the ability to judge, analyse, synthesise, critique. Problem-posing and problem-solving practices tend to encourage students to talk, pose questions, take risks, experiment, reflect and share ideas. These practices also suggest evaluative thinking - examining how they arrived at their decisions, and making judgements about quality – of the processes they used and the products they created.

The work of Moos and Azvedo (2009) and Chism (2006) allude to the importance of students applying metacognitive skills. Active learning processes align with Edgar Dale's (1969) cone of learning, in which 'doing the real thing' or simulating experiences supports the effective long-term memory of new learning. Additionally, while students are together actively engaged in grappling with content and concepts with and through technological means, they articulate their reasoning and thinking processes in order to complete the task and develop new understanding. The gaming practices Gee (2003) examined link to similar knowledge creation processes that involve interaction, problem-solving and trial-and-error. These tasks, by their nature, inherently require students to engage in higher order thinking processes. Gee argues that these cognitive skills also link to what it means to be literate. When these ideas are aligned with the pedagogical practices which become foregrounded in e-Learning rich classrooms, the link between more purposeful thinking and active learning becomes clear. They also link to the growing body of knowledge about multiliteracies.

'Multiliteracies' is a term coined by the New London Group in order to describe what constitutes literacy in the 21st century. The term acknowledges the idea of textual multiplicity. This idea encompasses the technological explosion of what constitutes a text, and considers this in relation to cultural and linguistic diversity and what it means to be literate. Another facet of this definition refers to the agency of making meaning, noting that this can be a critical factor in social change. The New London Group (Cazden, Cope, Fairclough, Gee, & et al, 1996) identified a number of ways through which meaning is made. These include:

- Linguistic Meaning - language in cultural contexts (sometimes linked to critical literacy)
- Visual Meaning - seeing and viewing
- Audio Meaning - hearing and sound
- Gestural Meaning – movement
- Spatial Meaning - space and place. ("Multiliteracies," n.d.)

In terms of e-Learning, this set of contexts for making meaning are important, since e-Learning contexts are likely to combine a number of these elements if the pedagogical practices are oriented to co-constructive processes. They also relate closely to what it means to be critically literate, and "supplements traditional literacy pedagogy" (Cazden et al., 1996).

McLeod and Vasinda (2008) argue that critical literacy and Web 2.0 affordances are intertwined. They propose that 21st century learners must be able to "carefully consider authors' intent and context and determine the purpose,

reliability, and credibility of information” (p. 260) because of the ubiquity of Web 2.0. They also argue that 21st century learners must be able to “think abstractly about problems, work collaboratively in teams, critically evaluate information, and perhaps even speak multiple languages” (p. 260). Thus, critical literacy is “no longer an option”. Web 2.0 affordances, which include blogs, Wikis, and podcasts, are so easy to use and create, that individuals as well as organisations and businesses can have a web presence. These tools, according to McLeod and Vasinda, mean that people can continually update anything they created on the Web, any time they choose as long as they have access to the Web.

This ability to continually individually and collectively make meaning, suggests loose and changeable connections among people who may move in and out of communities of practice in both formal and informal contexts. As Wan et al. (2008) noted, the virtual competence of users of e-Learning tools in terms of socialisation protocols might be hugely important when these affordances are corralled for educational use. When users can alter texts and interpretations at will, the locus of control regarding information and knowledge is altered. ‘Mashing’ and ‘modding’ can be both individual and collective efforts, creating new artefacts and ways of perceiving the world, thus potentially creating a constant state of reinvention². These are multiliteracies in action.

Critical literacy – the ability of readers to evaluate, critique and transform texts - is thus an important skill for learners to develop. This is because readers are no longer confined to the role of passive recipients, but can become active creators of information and knowledge. Only by becoming a critically literate learner will a student be better able to detect authorial intent and perspective, judge reasons for the existence of specific texts, and make reasonable guesses about what and why specific elements have been excluded or included. Essentially, “When readers consider issues behind the text, question the author’s perspective and intent, and reflect upon how they are changed because of the encounter with the text, they are approaching reading from a critical perspective or stance” (McLeod & Vasinda, 2008, p. 261).

A clear implication of students developing these metacognitive and critical thinking skills, plus becoming active creators of information through using Web 2.0 programs, is that teachers are no longer the educational controllers of either information or knowledge production. Instead, they become the facilitators of opportunities for students to engage in critical and analytical thinking about various kinds of texts and environments. This suggests something of the importance of integrating ICT tools into content areas and teaching both students and teachers how to be critical users of technology in situated contexts.

A primary school class in Finland demonstrated this well (Teachers TV, 2006). The teacher described the collaborative uses to which the ICT tools were put, increasing the ability of students to not only build on the knowledge that other students have created, but also make links to the wider learning community of which they are part. The teacher talked of this as progressive learning, which could also be understood as a version of scaffolding. And while these students developed their skills as ICT users, they were engaged in content learning across the curriculum and using a variety of texts and affordances to do so, thus demonstrating multimodal (ie working across a range of modes, such as visual, oral, symbolic, written, moving, static) behaviours and multiliteracies in action.

As Mcvee, Bailey and Shanahan (2008) argue, teachers’ approaches to the demands of learning, their knowledge of and about multimodal text design, plus their attitudes to literacy/multiliteracies and technology, may be more important to students’ learning than any particular ICT tools they use. The ability to integrate the tools into authentic learning opportunities appears to be a significant factor in successful ICT/e-Learning environments.

² see <http://patchworkearth.net/?p=74> for examples of this.

Conclusion

This review has examined and defined some key terms in the light of the guiding research questions. It has also examined some international and national literature in the field of e-Learning and outcomes as they relate to schooling. Unpublished texts (such as theses), national policy documents, journal articles and websites have been reviewed. Key sorting mechanisms related to the age of texts (mainly within the past five years), their context (schooling rather than tertiary contexts), and country of origin were also used to narrow the field.

Benefits

To summarise, benefits to school learners with access to e-Learning affordances, include:

Motivation and engagement: Stevenson's (2008) thesis identified Web 2.0 affordances as being useful here. These same affordances involve the social networking practices common among girls, and being harnessed by boys as well. Connecting in groups is also a feature often attributed to Maori and Pasifika learners and so including social networking practices in classrooms may support their learning (Ako Aotearoa, 2008; Franken et al., 2005). The tools which support motivation and engagement, as well as co-constructive pedagogies can also be factors in powerful learning that meet students' needs in a range of contexts and at a range of stages of learning, including ESL and physical disability.

Independence and personalised learning: personalising learning can mean students are more motivated to continue engaging in learning because they can more readily access support when it is needed. Some 2009 e-Learning fellows' experiences through their blogs demonstrates this well (see <http://elearningresearchnetwork.ning.com/page/efellows-1>). Claire Amos's blog, documenting using blogs for developing student writing, is a case in point. She commented that students regularly read each other's postings as a means of developing their own work, and even when they lost notebooks, their online work was still available (<http://mye-learningfellowshipjournal.blogspot.com/>). Web 2.0 applications (such as blogs), mobile devices, IWBs and other equipment can be useful in supporting personalised learning, as well as students' existing knowledge of online socialisation protocols which can help them successfully navigate online relationships (Lewin, Mavers & Somekh, 2003; Lewin, Somekh, & Steadman, 2008; Wan et al., 2008).

Critical thinking and multiliteracies: these features point to the importance of student-centred pedagogies that allow students to engage with multiple texts, collaborate with others and develop deep understanding. These pedagogies imply the development of metacognitive strategies that support students being able to access prior knowledge, interact with other people and various kinds of texts, create meaning and produce evidence of this new knowledge. The kinds of learning processes, contexts, literacies and media predicted by the New London Group (Cazden et al., 1996) are particularly important for e-Learning classrooms because they closely link to the kinds of co-constructive and socially mediated learning that technological tools appears to foster.

Access to information, resources and experts: this is one of the strengths of e-Learning affordances, because they make information and knowledge quickly and flexibly accessible. Students can manipulate and navigate such texts in various ways that suit how they might prefer to work. These texts (whether electronic, written or human) can be interpreted, analysed and reformed by learners, because the technologies exist which allow them to mash and mod the texts, creating new ones for real, but cyber audiences. In these ways, students can become producers and publishers of their own texts.

Collaboration in wide contexts, including international ones: Stevenson's (2008) thesis discusses such arrangements. The ongoing production of student podcasts and integration of other e-Learning technologies at Pt England School, also point to the power of international collaboration and audiences in motivating students to learn. It appears that this kind

of learning centres on the motivators of relevance, purpose, context, immediacy, audience, creativity, collaboration and pliability for students. In turn, such regular and integrated access to these technologies, enhance more traditional skill development such as literacy and numeracy (Burt, 2007). In these kinds of contexts, students are learning about, with and through technology. This has positive impact on their social, cognitive and affective domains (Falloon, 2004).

Some conditions which lead to positive outcomes include: the role of the teacher, the types of pedagogy used in technologically able classrooms, and the ubiquity of access to technology for everyone concerned. These presuppose effective leadership at a variety of levels within a school - teachers' professional development and mentoring, technical support, provision of equipment, and a drive to support e-Learning as fundamental aspect of classroom learning. It may also affect the way timetables are constructed, especially in secondary schools.

Cautions

The hype about e-Learning must be tempered with evidence about what works and how it works; some of that evidence is shaky, and may not withstand the consequences of the Hawthorne Effect over time. Some of the evidence used in this review relies on specific proprietary tools such as IWBs in classrooms. However, these can also demonstrate positive learning outcomes over time (Lewin, Somekh, & Steadman, 2008) when coupled with co-constructive pedagogies. Thus, teachers' pedagogic actions may be prime indicator of successful integration of technological tools into learning opportunities. This points to how important it is for teachers to actively engage with facilitating the use of such tools; merely having them will not lead to improved learning.

In terms of the potential of mobile devices to support learning in creative and just-in-time ways, there is still a long way to go. This is still in its infancy, and teachers wanting to use such tools must overcome both schools' reluctance to actively use such tools as part of learning, and concerns about theft, cyber bullying and access to objectionable sites.

Other cautions include assumptions around the availability of high-quality broadband/wifi access, and the extent to which students can be expected to retain high levels of motivation and engagement when e-Learning becomes normalised.

A final caution relates to teachers' attitudes and beliefs regarding technological tools. Evidence exists that teachers who use digital tools to replace older technology, but use them without altering their pedagogy, will have minimal effects on learning. For example, teachers who use presentation software to replace overhead transparencies, and continue to lecture, soon find that students tire of the novelty because their role in the classroom remains the same ("e-Learning Pedagogy," n.d.). Essentially, nothing will have changed for learners if they remain passive recipients of knowledge and information, even if the tools the teachers use are novel. The combination of technology and more student-centred, facilitative pedagogies appear to be at the heart of effective e-Learning in classrooms.

Limitations and gaps

Some limitations of the study have already been alluded to: the timeline, the scope and aspects of the methodology. There are also gaps in this review. It did not, for example, address the following vis a vis e-Learning in much or any substantive detail:

- Gender
- Ethnicity or disability
- Specific differences between primary and secondary
- Student voice
- Language (first language versus second/third languages)
- Teacher knowledge and professional development.

These gaps exist in this review because few of the texts either deliberately focus on these areas of interest in the relevant time period, or also address 'outcomes'. These are therefore areas of interest to future research in the arena of e-Learning and outcomes.

Summary

This e-Learning literature review has attempted to demonstrate the extent to which these following questions can be answered:

- What is the nature of existing evidence linking e-Learning to improved learning outcomes for students in primary and secondary schools?
- What teaching and learning practices maximise (any) benefits of using e-Learning?

In terms of the first question, this review suggests that if 'outcomes' is understood to include wider social, cognitive and affective effects, then it is possible to say that e-Learning affordances have a positive effect on outcomes. The nature of the existing evidence indicates that when good teaching occurs in tandem with appropriate e-Learning technologies, then students are more likely to benefit and be able to work and learn in ways that feel more natural to them. The available evidence also points to a greater focus on specific tools rather than the teaching and learning processes by which they are successfully used. The body of literature about the ways IWBs can enhance learning is a case in point. There is also a growing literature on Web 2.0 affordances and mobile technologies, and the work of the 2009 e-Learning fellows³ demonstrate how these can be used to support students' growing confidence and skills as thinking citizens.

As far as practices that maximise e-Learning benefits, pedagogies which privilege collaboration, communication, sharing, problem-solving and risk-taking appear to lead to greater student engagement and sustained concentration – key aspects of achievement. They are also referred to most often in literature on e-Learning topics. These mainly co-constructive pedagogical practices appear to develop even when teachers have not deliberately included such approaches; this may be because they fit with students' preferred ways of using these technologies. The preponderance of social networking in young people's technological lives may also contribute to this way of learning, but this is an as yet untested hunch. And while many students are digital natives in the sense of being 'at home' with technology, they nevertheless are new to using these same tools educatively and beyond social or immediate purposes.

It is *still* the role of the teacher to harness these tools purposefully and to teach students to benefit from using these ubiquitous tools for learning. A key component of effective learning is the development of critical thinking and metacognition. These go hand in hand with effective literacy practices in schools, and integrating key components of programmes such as Te Kotahitanga to create the best possible conditions for students' learning. These points also bring into sharp relief the importance of the 'C' in ICT: *communication* (of ideas, concepts, methods, practices, knowledge) is a fundamental component of the kinds of pedagogies that link closely to embedded, integrated uses of e-Learning, and link to positive achievement outcomes for students over time.

³ These can be found at <http://www.efellows.org.nz/>

References

- Abrami, P., Bernard, R., Wade, A., Borokhovski, E., Tamin, R., Surkes, M., & Zhang, D. (2008). A review of e-learning in Canada: Rejoinder to commentaries. *Canadian Journal of Learning and Technology / La revue canadienne de l'apprentissage et de la technologie*, 32(3). Retrieved from <http://www.cjlt.ca/index.php/cjlt/article/view/48/45>
- Ako Aotearoa. (2008). *Designing for diversity*. Retrieved March 25, 2010, from <http://ako.aotearoa.ac.nz/community/recommended-resources-ako-aotearoa/resources/books/designing-diversity>
- Alexander, B. (2008). Web 2.0 and emergent multiliteracies. *Theory into practice*, 47(2), 150. doi:10.1080/00405840801992371
- Alexander, S. (2001). E-learning developments and experiences. *Education + Training*, 43(4/5), 240 - 248. doi:10.1108/00400910110399247
- de Almeida Soares, D. (2008). Understanding class blogs as a tool for language development. *Language Teaching Research*, 12(4), 517-533. doi:10.1177/1362168808097165
- Alton-Lee, A. (2003). *Quality teaching for diverse students: Best evidence synthesis*. Wellington, New Zealand: Ministry of Education.
- Annetta, L. A., Minogue, J., Holmes, S. Y., & Cheng, M. (2009). Investigating the impact of video games on high school students' engagement and learning about genetics. *Computers & Education*, 53(1), 74-85. doi:10.1016/j.compedu.2008.12.020
- Assogba, Y., & Donath, J. (2009). *Mycrocosm: Visual Microblogging*. In proceedings of the 42nd annual Hawaii international conference on system sciences, HICSS, January 5-8, 2009. Retrieved from <http://www.computer.org/portal/web/csdl/proceedings/h#4>
- Ballantyne, L. M. (2004). In what ways could ICT teaching and learning take place at Orewa college? Osmosis, integration and/or specialist subjects? (Master of Education thesis). Massey University, Palmerston North, New Zealand.
- Bennett, S., & Lockyer, L. (2008). A study of teachers' integration of interactive whiteboards into four Australian primary school classrooms. *Learning, Media and Technology*, 33(4), 289. doi:10.1080/17439880802497008
- Bishop, R., & Berryman, M. (2006). *Culture speaks: Cultural relationships and classroom learning*. Wellington, New Zealand: Huia Press.
- Blignaut, S., & Nagel, L. (2009). Cousins Virtual Jane and Virtual Joe, extraordinary virtual helpers. *Computers & Education*, 53(1), 104-111. doi:10.1016/j.compedu.2009.01.003
- Boling, E., Castek, J., Zawilinski, L., Barton, K., & Nierlich, T. (2008). Collaborative literacy: blogs and internet projects. *Reading Teacher*, 61(6), 504-506. Retrieved from <http://search.ebscohost.com.ezproxy.waikato.ac.nz/login.aspx?direct=true&db=aph&AN=31195721&site=ehost-live>

- Bolstad, R., & Gilbert, J. (2006). Creating digital age learners through school ICT projects: What can the Tech Angels project teach us? *Education Counts*. Wellington: New Zealand Council for Educational Research. Retrieved from <http://www.educationcounts.govt.nz/publications/ict/6518>
- Bonk, C. J. (2009). *The world is open: How web technology is revolutionizing education*. San Francisco, CA: Jossey Bass.
- Borau, K., Ullrich, C., Feng, J., & Shen, R. (2009). Microblogging for language learning: using Twitter to train communicative and cultural competence. *SlideShare*. Shanghai Jiao Tong University. Retrieved from <http://www.slideshare.net/ullrich/microblogging-for-language-learning-using-twitter-to-train-communicative-and-cultural-competence>
- Burke, A., & Rowsell, J. (2008). Screen pedagogy: Challenging perceptions of digital reading practice. *Changing English*, 15(4), 445. doi:10.1080/13586840802493092
- Burkett, E. (2008). 'A new way of looking?' Reflections upon one teacher's experience of supporting learners using handheld computers. *Educational Action Research*, 16(4), 481-493. doi:10.1080/09650790802445668
- Burt, D. (2007). *The lure of podcasting (summary document)*. *e fellows: research for teachers by teachers*. Wellington, New Zealand: Ministry of Education. Retrieved from <http://www.efellows.org.nz/index-reports>
- Cadogan, M. D. (2009). Web 2.0 rollercoaster. A ride we should all take. *Emergency Medicine Australasia*, 21(1), 1-3.
- Campbell, N. (2001). *e-teaching, e-learning and e-education*. A paper to inform the development of the ICT Strategy in New Zealand for the Ministry of Education Retrieved from <http://cms.steo.govt.nz/NR/rdonlyres/C11315DE-804A-4831-AB75-3D4E77393DD8/0/eteaching.htm>
- Cazden, C., Cope, B., Fairclough, N., Gee, J., & et al. (1996). A pedagogy of multiliteracies: Designing social futures. *Harvard Educational Review*, 66(1), 60.
- CERI-KERIS International Expert Meeting on ICT & Educational Performance. (2007). Cheju Island, South Korea: Organisation for Economic Co-operation and Development. Retrieved from http://www.oecd.org/document/53/0,3343,en_2649_35845581_39381877_1_1_1_1,00.html
- Chandra, V. (2004). The impact of a blended web-based learning environment on the perceptions, attitudes, and performance of boys and girls in junior science and senior physics. (Doctoral thesis, Curtin University of Technology, Australia). Retrieved from http://espace.library.curtin.edu.au:80/R/?func=dbin-jump-full&object_id=15943
- Chen, W., Tan, N. Y. L., Looi, C., Zhang, B., & Seow, P. S. K. (2008). Handheld computers as cognitive tools: Technology-enhanced environmental learning. *Research and Practice in Technology Enhanced Learning*, 3(3), 231-252.
- Chettle, J. (2009, September 27). Not just passing fad, blogs have become influential. *Richmond Times-Dispatch*, 100-103. Retrieved from <http://library.pressdisplay.com.ezproxy.waikato.ac.nz/pressdisplay/viewer.aspx?#>
- Chism, N. V. N. (2006). Challenging traditional assumptions and rethinking learning spaces. In D. G. Oblinger (Ed.), *Learning Spaces* (pp. 2.0-2.12). Educause. Retrieved from www.educause.edu/learningspaces

- Claro, M. (2007). OECD Background Paper for OECD-KERIS Expert Meeting: Information and Communication Technologies and Educational Performance. OECD. Retrieved from www.oecd.org/dataoecd/0/19/39485718.pdf
- Clyde, L. A. (2005). Educational blogging. *Teacher Librarian*, 32(3), 43-45. Retrieved from <http://search.ebscohost.com.ezproxy.waikato.ac.nz/login.aspx?direct=true&db=aph&AN=16251588&site=ehost-live>
- Conole, G., & Dyke, M. (2004). Discussion Understanding and using technological affordances: a response to Boyle and Cook. *ALT-J*, 12(3), 301-308. doi:10.1080/0968776042000259609
- Convery, A. (2009). The pedagogy of the impressed: how teachers become victims of technological vision. *Teachers and Teaching*, 15(1), 25. doi:10.1080/13540600802661303
- Corbett, S., Mace, K., & Regehr, G. (n.d.). *Twitter in the online classroom: Case Study Report* (No. ED 690). San Diego, CA: San Diego State University.
- Cosh, K. J., Burns, R., & Daniel, T. (2008). Content clouds classifying content in Web 2.0. *Library Review*, 57(9), 722-729.
- Cowie, B., Jones, A., Harlow, A., McGee, C., Cooper, B., Forret, M., Miller, T., et al. (2008). *TELA: Laptops for teachers evaluation, Final report, years 9 - 13*. Wellington, New Zealand: Ministry of Education. Retrieved from www.educationcounts.govt.nz/publications
- Cristina, C. (n.d.). Microblogging in technology enhanced learning: A use-case inspection of PPE Summer School 2008. Retrieved from <https://together.eu/handle/123456789/365?action=1>
- Csikszentmihalyi, Michal. (1990). *Flow: The psychology of optimal experience*. New York: HarperCollins.
- Dale, C., & Pymm, J. M. (2009). Podagogy: The iPod as a learning technology. *Active Learning in Higher Education*, 10(1), 84-96. doi:10.1177/1469787408100197
- Dale, E. (1969). *Audio-visual methods in teaching* (3rd ed.). New York: Holt, Rinehart and Winston.
- Dillenbourg, P. (2008). Integrating technologies into educational ecosystems. *Distance Education*, 29(2), 127. doi:10.1080/01587910802154939
- Douglas, R., & Kerr, N. (2010, February 7). Mobile learning champions [Video file]. Retrieved from http://www.youtube.com/watch?v=I3Hzr8lZdPU&feature=youtube_gdata
- Earl, K., & Forbes, D. (2008). Information communication technology: Destinations, highways, signposts and speedbumps. In C. McGee & D. Fraser (Eds.), *The Professional Practice of Teaching* (3rd ed.) (pp. 189-203). Melbourne: Cengage.
- Elearning Pedagogy. (n.d.). SAE Online. Retrieved March 25, 2010, from <http://saeonline.com/about/elearning-pedagogy>
- Falloon, G. (2004). An analysis of the impact of an e-classroom environment on the social, cognitive and affective elements of student work practices (Doctoral thesis). Curtin University of Technology, Australia.

- FLAG Secretariat, O. O. T. A. T. E. (2003, March 2). Australian Flexible Learning Framework for Vocational Education and training. Retrieved May 6, 2009, from <http://pre2005.flexiblelearning.net.au/aboutus/jargonbuster.htm>
- Franken, M., May, S., & McComish, J. (2005). *Pasifika languages research and guidelines project: Literature review* (p. 98). Hamilton, New Zealand: Wilf Malcolm Institute of Educational Research, The University of Waikato.
- Gee, J. P. (2003). *What video games have to teach us about learning and literacy*. Gordonsville, VA, USA: Palgrave Macmillan.
- Gilbert, J. (2005). *Catching the Knowledge Wave? The knowledge society and the future of education* (1st ed.). Wellington, New Zealand: NZCER Press.
- Grant, L. (2009). 'I DON'T CARE - DO - UR - OWN - PAGE!' A case study of using wikis for collaborative work in a UK - secondary school. *Learning, Media and Technology*, 34(2), 105. doi:10.1080/17439880902923564
- Greenhow, C., & Robelia, B. (2009). Informal learning and identity formation in online social networks. *Learning, Media and Technology*, 34(2), 119. doi:10.1080/17439880902923580
- Grenfell, M. (2007). Pierre Bourdieu: Education and training. Continuum library of educational thought (Vol. 2). London & New York: Continuum.
- Ham, V. (2008). *National trends in the ICT PD School Cluster Programme 2004-2006* (Final). Christchurch, New Zealand: CORE Education.
- Ham, V. (2009). *Outcomes for teachers and students in the ICT PD School Clusters Programme 2005-2007 - A national overview*. Education Counts. Retrieved March 16, 2010, from <http://www.educationcounts.govt.nz/publications/ict/49515/1>
- Hardré, P. L., & Sullivan, D. W. (2009). Motivating adolescents: high school teachers' perceptions and classroom practices. *Teacher Development: An international journal of teachers' professional development*, 13(1), 1. doi:10.1080/13664530902858469
- Hartnell-Young, E., & Vetere, F. (2008). A means of personalising learning: incorporating old and new literacies in the curriculum with mobile phones. *Curriculum Journal*, 19(4), 283-292. doi:10.1080/09585170802509872
- Hayes, D. N. (2007). ICT and learning: Lessons from Australian classrooms. *Computers & Education*, 49(2), 385-395. doi:10.1016/j.compedu.2005.09.003
- Heafner, T. L., & Friedman, A. M. (2008). Wikis and constructivism in secondary social studies: Fostering a deeper understanding. *Computers in the Schools*, 25(3), 288-302. doi:10.1080/07380560802371003
- Jackson, J. (2009). Game-based teaching: what educators can learn from videogames. *Teaching Education*, 20(3), 291. doi:10.1080/10476210902912533
- James, M. (2006). *Learning how to learn in classrooms, schools and networks* (document No. 17). Research Briefing (pp. 1-4). London: Teaching and Learning Research programme: ESRC. Retrieved from www.tlrp.org

- Johna, P., & Sutherland, R. (2005). Affordance, opportunity and the pedagogical implications of ICT. *Education Review*, 57(4), 405-413.
- Johnson, L., Levine, A., Smith, R., & Stone, S. (2010). *The 2010 Horizon Report*. Austin, Texas: The New Media Consortium. Retrieved from <http://wp.nmc.org/horizon2010/>
- Keller, J. M. (2008). First principles of motivation to learn and e3-learning. *Distance Education*, 29(2), 175-186. doi:10.1080/01587910802154970
- Kennewell, S. (2008). *Interactive teaching and ICT (Research Brief)*. Teaching and Learning Research Programme (pp. 1-2). London: Teaching and Learning Research programme: ESRC. Retrieved from www.interactive-teaching.org.uk
- Kent, P. (2004). E-teaching and interactive whiteboards : the Richardson experience. *Practising Administrator*, 26(1), 14-16. Retrieved from <http://search.informit.com.au.ezproxy.waikato.ac.nz/documentSummary;dn=136383;res=AEIPT>
- Kent, P., & Holdway, M. (2009). Interactive whiteboards, productive pedagogies and literacy teaching. *Literacy Learning: The Middle Years*, 17(1), 21-25.
- Kim, B., Park, H., & Baek, Y. (2009). Not just fun, but serious strategies: Using meta-cognitive strategies in game-based learning. *Computers & Education*, 52(4), 800-810. doi:10.1016/j.compedu.2008.12.004
- Krumsvik, R. (2009). Situated learning in the network society and the digitised school. *European Journal of Teacher Education*, 32(2), 167-185. doi:10.1080/02619760802457224
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, England: Cambridge University Press.
- Law, N. (2008). Summary and Reflections. In W. J. Pelgrum, T. Plomp, & N. Law (Eds.), *Pedagogy and ICT use in schools around the world: Findings from the IEA SITES 2006 study*, CERC Studies in Comparative Education (Vol. 23, p. 296). Hong Kong: CERC-Springer. Retrieved from <http://dx.doi.org/10.1007/978-1-4020-8928-2>
- Law, N., Pelgrum, W. J., & Plomp, T. (2008). *Pedagogy and ICT Use*. Retrieved from <http://dx.doi.org/10.1007/978-1-4020-8928-2>
- Learn 4 Life. (2009, September 17) *What happens when you give a class of 8 year old children an iPod touch each?* Retrieved March 25, 2010, from <http://www.l4l.co.uk/?p=835>
- Lee, M. (2003). Reflecting on the last decade : the profound technological change: minimal change in schooling. *Practising Administrator*, 25(4), 20-21. Retrieved from <http://search.informit.com.au.ezproxy.waikato.ac.nz/documentSummary;dn=130695;res=AEIPT>
- Lee, M. (2004). Into the information age: is it time to revisit your ICT and education strategy? *Practising Administrator*, 26(2), 24-25. Retrieved from <http://search.informit.com.au.ezproxy.waikato.ac.nz/documentSummary;dn=136542;res=AEIPT>

- Lewin, C., Mavers, D., & Somekh, B. (2003). Broadening access to the curriculum through using technology to link home and school: a critical analysis of reforms intended to improve students' educational attainment. *Curriculum Journal*, 14(1), 23-53. doi:Article
- Lewin, C., Somekh, B., & Steadman, S. (2008). Embedding interactive whiteboards in teaching and learning: The process of change in pedagogic practice. *Education and Information Technologies*, 13(4), 291-303. doi:10.1007/s10639-008-9070-z
- Lim, C. P., & Hang, D. (2003). An activity theory approach to research of ICT integration in Singapore schools. *Computers & Education*, 41(1), 49-63. doi:10.1016/S0360-1315(03)00015-0
- Luckin, R., Clark, W., Graber, R., Logan, K., Mee, A., & Oliver, M. (2009). Do Web 2.0 tools really open the door to learning? Practices, perceptions and profiles of 11–16-year-old students. *Learning, Media and Technology*, 34(2), 87. doi:10.1080/17439880902921949
- Luehmann, A. L. (2008). Blogs' affordances for identity work: Insights gained from an urban teacher's blog. *The New Educator*, 4(3), 175-198. doi:10.1080/15476880802234797
- Maddux, C. D., & Johnson, D. L. (2009). Information technology in education: The need for a critical examination of popular assumptions. *Computers in the Schools*, 26(1-3), 1. doi:10.1080/07380560802688232
- McLeod, J., & Vasinda, S. (2008). Critical literacy and Web 2.0: Exercising and negotiating power. *Computers in the Schools*, 25(3), 259-274. doi:10.1080/07380560802394815
- McVee, M. B., Bailey, N. M., & Shanahan, L. E. (2008). Teachers and teacher educators learning from new literacies and new technologies. *Teaching Education*, 19(3), 197. doi:10.1080/10476210802250216
- Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2009). *Evaluation of evidence -based practices in online learning: A meta-analysis and review of online learning studies*. U.S. Department of Education Office of Planning, Evaluation, and Policy Development Policy and Program Studies Service. Retrieved from www.ed.gov/about/offices/list/oepd/ppss/reports.html
- Mentis, M. (2008). Navigating the e-learning terrain: Aligning technology, pedagogy and content. *ECEL: The European Conference on e-learning*, 6(3), 217-226.
- Ministerial Council on Education, Employment, Training and Youth Affairs (Australia and New Zealand). (2005). *Pedagogy strategy: Learning in an online world*. Curriculum Corporation.
- Ministry of Education. (2002). *Digital Horizons: learning through ICT*. Ministry of Education, New Zealand.
- Ministry of Education. (2006). *Enabling the 21st Century Learner - e-Learning Action Plan for Schools 2006-2010*. Learning Media Ltd. Retrieved from <http://www.minedu.govt.nz/educationSectors/Schools/Initiatives/ICTInSchools/ICTInitiativesAndProgrammes/EnablingThe21stCenturyLearner.aspx>
- Ministry of Education. (2007). *The New Zealand Curriculum*. Wellington, New Zealand: Learning Media.
- Ministry of Education. (2008). Key evidence: And how we must use it improve system performance for Maori Ka Hikitia Managing for Success: Maori Education Strategy 2008-2012. Learning Media Ltd.

- Ministry of Education, Singapore. (n.d.) *Desired Outcomes of Education*. Retrieved from <http://www.moe.gov.sg/education/desired-outcomes/#desired-outcomes-what>
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017-1054.
- Mishra, P., & Koehler, M. (2009). Too cool for school? No way! Using the TPACK framework: You can have your hot tools and teach with them, too. *Learning & Leading with Technology*, 36(7), 14-18. Retrieved from <http://www.eric.ed.gov/ERICWebPortal/contentdelivery/servlet/ERICServlet?accno=EJ839143>
- Mitchell, B., Bailey, J., & Monroe, E. (2007). Integrating technology and a standards-based pedagogy in a geometry classroom. *Computers in the Schools*, 24(1), 75-91. doi:10.1300/J025v24n01_06
- Mitchell, L. M. (2007). Using technology in Reggio Emilia-Inspired programs. *Theory Into Practice*, 46(1), 32. doi:10.1080/00405840709336546
- Moos, D., & Azevedo, R. (2009). Learning with computer-based learning environments: A literature review of computer self-efficacy. *Review of Educational Research*, 79(2), 576-600.
- Nicholas, H., & Ng, W. (2009). Engage secondary school students in extended and open learning supported by online technologies. *Journal of Research on Technology in Education*, 41(3), 305-328.
- Nussbaum, M., Alvarez, C., McFarlane, A., Gomez, F., Claro, S., & Radovic, D. (2009). Technology as small group face-to-face Collaborative Scaffolding. *Computers & Education*, 52(1), 147-153. doi:10.1016/j.compedu.2008.07.005
- OECD. (2005). Are students ready for a technology-rich world? What PISA tells us. Programme for International Student Assessment (p. 138). Paris, France: Organisation for Economic Co-operation and Development.
- Prensky, M. (2001a). Digital natives, digital immigrants. *On the Horizon*, 9(5), 1-6. Retrieved from <http://209.85.173.104/search?q=cache:Yvdyw3gWkxwJ:www.marcprensky.com/writing/Prensky%2520-%2520Digital%2520Natives,%2520Digital%2520Immigrants%2520-%2520Part1.pdf+prensky+digital+natives&hl=en&ct=clnk&cd=1&gl=nz&client=firefox-a>
- Prensky, M. (2001b). Do they really think differently? *On the Horizon*, 9(6), 1-9.
- Prensky, M. (2006). *Digital natives, digital immigrants. Learners Together*. Retrieved from <http://www.learnerstogether.net/digital-natives-digital-immigrants/53>
- Reid, C. (2009). Technology-loving Luddites? Declining participation in high school computing studies in Australia. *British Journal of Sociology of Education*, 30(3), 289-302. doi:10.1080/01425690902812562
- Reisz, M. (2009). Short and tweet: modern philosophy and Twitter. *Times Higher Education*, (1911), 10.
- Richardson, L. (1997). *Fields of play: constructing an academic life*. New Brunswick, New Jersey: Rutgers University Press.
- Rogers, Y., & Price, S. (2008). The role of mobile devices in facilitating collaborative inquiry in situ. *Research and Practice in Technology Enhanced Learning*, 3(3), 209-229.

- Rumpagaporn, M. (2007). Students' critical thinking skills, attitudes to ICT and perceptions of ICT classroom learning environments under the ICT schools pilot project in Thailand (Doctoral thesis). The University of Adelaide, Australia. Retrieved from <http://hdl.handle.net/2440/37896>
- Selwyn, N. (2009). We think therefore we share: reading the thoughts of the digerati 2.0. *Learning, Media and Technology*, 34(2), 191. doi:10.1080/17439880902923697
- Smyth, J., & Hattam, Robert. (2004). 'Dropping out', drifting off, being excluded: Becoming somebody without school. *Adolescent Cultures, School and Society* (Vol. 22). New York: Peter Lang.
- Somekh, B, Underwood, J., Convery, A., Dillon, G., Jarvis, J., & Lewin, C. (2007). *Evaluation of the ICT Test Bed project* (Final). Centre for ICT, Pedagogy and Learning Education and Social Research Institute, Manchester Metropolitan University, Division of Psychology, Nottingham Trent University: BECTA.
- Somekh, B. (2007). *Pedagogy and learning with ICT: Researching the art of innovation*. New York NY: Routledge.
- Spikol, D., & Milrad, M. (2008). Physical activities and playful learning using mobile games. *Research and Practice in Technology Enhanced Learning*, 3(3), 275-295.
- Sprague, D., & Pixley, C. (2008). Podcasts in education: Let their voices be heard. *Computers in the Schools*, 25(3), 226-324. doi:10.1080/07380560802368132
- Squire, K. (2008). Videogames literacy: A literacy of expertise. In J. Coiro, D. J. Leu, C. Lankshear, & M. Knobel (Eds.), *Handbook of Research in New Literacies*. New York: Taylor and Francis.
- Stevenson, L. (2008). *Personalised learning in a Web 2.0 environment*. (Master of Education thesis). Waikato. Retrieved from <http://adt.waikato.ac.nz/public/adt-uow20080930.180122/index.html>
- Stokes, D. (2008). Blogging for beginners. *Learning Disability Practice*, 11(3), 16-18.
- Sutherland, R. (2004). Designs for learning: ICT and knowledge in the classroom. *Computers & Education*, 43(1-2), 5-16. doi:10.1016/j.compedu.2003.12.017
- Teachers TV. (2006, June 30). Primary ICT - Natural connections [Video file]. Retrieved from <http://www.teachers.tv/video/4977>
- Tearle, P. (2004). *The implementation of ICT in UK secondary schools* (Final Report). UK: University of Exeter.
- Timperley, H., Wilson, A., Barrar, H., & Fung, I. (2007). *Teacher professional learning and development: Best Evidence Synthesis Iteration (BES)*. Wellington: Ministry of Education. Retrieved from <http://www.educationcounts.govt.nz/publications/series/2515/15341>
- Twiss, T. (2008). *Ubiquitous information*. Wellington: Ministry of Education. Retrieved from http://tonitwiss.com/mobile/?page_id=35
- Underwood, J., & Banyard, P. (2008). Managers', teachers' and learners' perceptions of personalised learning: evidence from Impact 2007. *Technology, Pedagogy and Education*, 17(3), 233. doi:10.1080/14759390802383850

-
- University of South Dakota. (n.d.) Glossary of Library and Internet Terms. Retrieved from <http://www.usd.edu/library/instruction/glossary.shtml>
- Van Dusen, C. (2009, June 25). 21st century teacher education. *eSchool News*. Retrieved from <http://eschoolnews.p2ionline.com/Flip/sitebase/index.aspx?adgroupid=130064&view=double&webstoryid=>
- Vygotsky, L. S. (1978). *Mind in society: Development of higher psychological processes*. (M. Cole, Ed.). Cambridge, USA: Harvard University Press.
- Wan, Z., Wang, Y., & Haggerty, N. (2008). Why people benefit from e-learning differently: The effects of psychological processes on e-Learning outcomes. *Information & Management*, 45(8), 513-521. doi:10.1016/j.im.2008.08.003
- Wright, N., May, S., Whitehead, D., Smyth, J., & Smyth, S. (2005). *Secondary Schools' Literacy Initiative Research Evaluation: Sustaining literacy initiatives in secondary schools*. Wilf Malcolm Institute of Education, The University of Waikato, Hamilton, New Zealand.