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Emerging E-pedagogy: New Teaching for New Learning

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Abstract

The 'digital generation' have only ever known a world saturated with digital information and communication technologies (ICT). Assuming there is access to digital technology in the home, by the time children start school they have already begun using computers for informal learning. By the end of primary school most children have begun establishing themselves as members of online communities that further support their informal learning in ways that are very different to those encountered in school classroom environments. Contrary to the perception of many adults, the hours spent in front of a computer screen or with a mobile phone in hand, do not serve to isolate young people, but rather to connect them to rapid multi-direction information sources and social networks to support their learning on many levels. As researchers and educators gradually come to understand the characteristics of the learning that takes place through the cyber-world, new pedagogies are being developed to engage the digital generation in schools, to promote necessary critical thinking skills and to mediate the inequity of access to technologies experienced by some children. However, meaningful integration of digital technologies into primary schools has been notoriously slow, with school leaders and innovative teachers being inhibited by many context-specific barriers, including infrastructure issues, teacher reluctance, and lack of information about pedagogical directions. Research conducted across 1500 Australian primary schools over a 3-year period resulted in the development of a three dimensional framework that articulates the characteristics of a hierarchy of phases that schools move through as they progress toward educational practices that harness the powerful learning styles of the digital generation. This paper presents this ICT Adoption Framework, emphasising emerging e-pedagogies, with the purpose illustrating a pathway forward into the 21st Century for schools.

Keywords: technology, pedagogy, digital-generation.

The recent past: 2002-2005

Using data collected from over 1500 primary schools via Literacy and/or Numeracy e-learning grant applications (2002 to 2005), a Framework was developed that accounts for the complexities of individual school environments and describes a hierarchy of integration levels for information and communication technologies. Table 1 presents an overview of the Framework, consisting of three dimensions, each with several categories that define the characteristics of ICT use in primary schools. The details about each category in the framework have been published elsewhere (Way & Webb, 2007; Way, 2009), and have served as a tool for describing and monitoring changes in ICT adoption in Australian primary schools.

The general trend could be broadly described as an upward shift in the three dimensions of the framework, with the majority (60%) of the schools located midway in the framework (Category 2). These schools typically had a computer to student ratio approaching the national average (1:6) and had most of their computers connected to the school network, as well as to the Internet. Many computers were distributed throughout the school, and classroom computers were commonly used in association with the computers located in computer labs and/or the library. Both students and teachers were focussed on developing the skills necessary to use the technology as tools for learning, teaching and communication. Though some new hardware and software appeared in 2005, such as interactive whiteboards and robotics programs, the approach to their adoption was similar to 2002. The opportunities presented by the technologies were perceived in terms of how the technologies could be used to enhance the curriculum priorities of the school. The technologies were described as 'educational tools', particularly effective when used in association with information processing and students using multimedia technologies to enhance literacy outcomes.

*Table 1: Three-dimensional analysis framework for ICT integration (*Way & Webb, 2007)

Dimension	Category 1	Category 2	Category 3	Category 4
ICT Infrastructure	Disconnected environment	Initially connected environment	Established connected environment	Multifaceted connected environment
Motivation and ICT Use	Situational – Reactive	Skills Oriented	Proactive – Higher Order	
Pedagogy and Innovation	ICT as an Innovative Object	ICT as a Curriculum Tool	New Learning Environment	

Of particular interest are the schools aligned with Category 3/4 in the framework (21% in 2005) whose projects represented changes in pedagogy and school culture, with the creation of new learning environments that use technology to extend learning beyond the mandated curriculum and beyond the confines of the classroom, to embrace e-learning. In these schools, pedagogies and learning environments that incorporated some of the characteristics of learning approaches used by the digital generation outside of school were being developed. The philosophies of these schools are reflected in the following two quotations from project descriptions:

> Learning will be internally controlled and mediated and be an active and reflective process. Knowledge will be constructed in multiple ways through the use of the above tools, resources, experiences and contexts. Social interaction will be through reflection, collaboration, negotiation and shared meaning. (School 238, 2005)

> In many instances, e-learning allows students to develop skills in accessing and selecting appropriate information, file management, problem identification, working with partners, negotiation, time management, goal setting, be creative in their choice of styles, format and visual impact in their work presentation and so on. These are transferable skills that they could apply in future learning. In addition, we believe that ICT enhances life long learning skills such as critical thinking, problem solving, research and analytical skills. The fact that it can cater for a wide range of learning abilities and styles means all students can benefit from it. (School 564, 2005)

Analysis of the project descriptions revealed several approaches to achieving the educational goals expressed by these schools. Some schools emphasised the collaborative creation and publication of 'products' such as online magazines with text, audio, animation and video, or online fantasy world. The teachers acknowledged the immersion of the digital generation in ICT-based environments, but also recognised inequities in children's experiences and the school's role in developing deeper understanding and critical awareness of the elements of digital environments for all students.

Other schools chose to utilise newly available software packages to focus on gaming, role-play, robotics and programming. In these projects, children were actively engaged in collaborative learning experiences that focus on *learning by doing*. The teachers justified the project's place in the curriculum through the opportunities to enhance literacy, numeracy, science and ICT skills, but also acknowledged the importance of developing these as *learning skills* in their own right, together with other learning skills such as collaboration, role play, game making, organization and problem solving.

The focus for some schools was connection, access and communication through establishing collaborative learning environments and virtual classrooms, connecting to the world beyond the classroom, or for achieving access to resources for special-needs children or remote and isolated communities. In their project descriptions, the teachers highlighted the role of social interactions in children's learning.

A number of projects applied scientific enquiry methods and made use of measurement tools and peripheral devices such as cameras, pedometers, data-loggers and scales to explore environmental and sustainability issues such as energy, waste management, biodiversity and water. Others used technology to access further specialised technology such as robotic telescopes. The projects often had a proactive community-based ecological goal such as the creation of a habitat, reclamation of wasteland or a creek, or the improvement of practices within the school. The teachers clearly viewed authentic tasks as way to engage students in meaningful learning experiences as well as a vehicle for developing multi-literacies and numeracy, but there was also an underlying sense of the child and the school being part of a wider, even global, community.

The present: 2007-2009

The current generation of school-aged children in the developed countries have been called 'digital natives' (Prensky, 2001) because digital technologies are integral to their daily lives. Unlike their parents and grandparents, they have never known a world without instant communication and access to information through mobile phones and the Internet. However, there are a variety of ways in which young people use technology, and also variation in the extent of their immersion in digital environments. In their report *Their Space*: *Education for the digital generation,* Green and Hannon (2007) have identified four types of technology users: *digital pioneers*, *creative producers*, *everyday communicators* and *information gatherers*. These typologies were based on surveys and interviews of 600 parents and 60 children aged 7-18 years in England. Although the typologies may not be definitive, anyone who has close contact with this age range, particularly outside school, will readily identify with the descriptions of their characteristics provided below.

- **Information gatherers** are avid users of search engines and are typically Google and Wikipedia addicts. They are skilled in the craft of 'cutting and pasting' information to build 'answers to questions' that may be self-generated but are more often school related. They expect to find what they are looking for quickly and do not always critically assess the reliability of the source or the content.

- **Everyday communicators**, the majority of young people view basic digital technologies as ubiquitous, almost mundane. They use mobile phones and computers for regular, repetitive tasks - for texting, talking on MSN and for basic information searches - simply to make their lives easier. Many will also engage in some of the activities of the Creative Producers, such as uploading photos and downloading music, but focus on strengthening their existing personal networks rather than widening them.

- **Creative producers** engage in 'active content creation' such as building websites, producing movies, manipulating images, displaying photos and creating music play-lists. They usually participate in active communities of interest, sharing their creations with friends, family and beyond. As well as providing an audience for their creative efforts, these informal networks provide opportunities for critical reflection and learning. They enjoy the entertainment value of digital technologies and are often keen 'online gamers'.

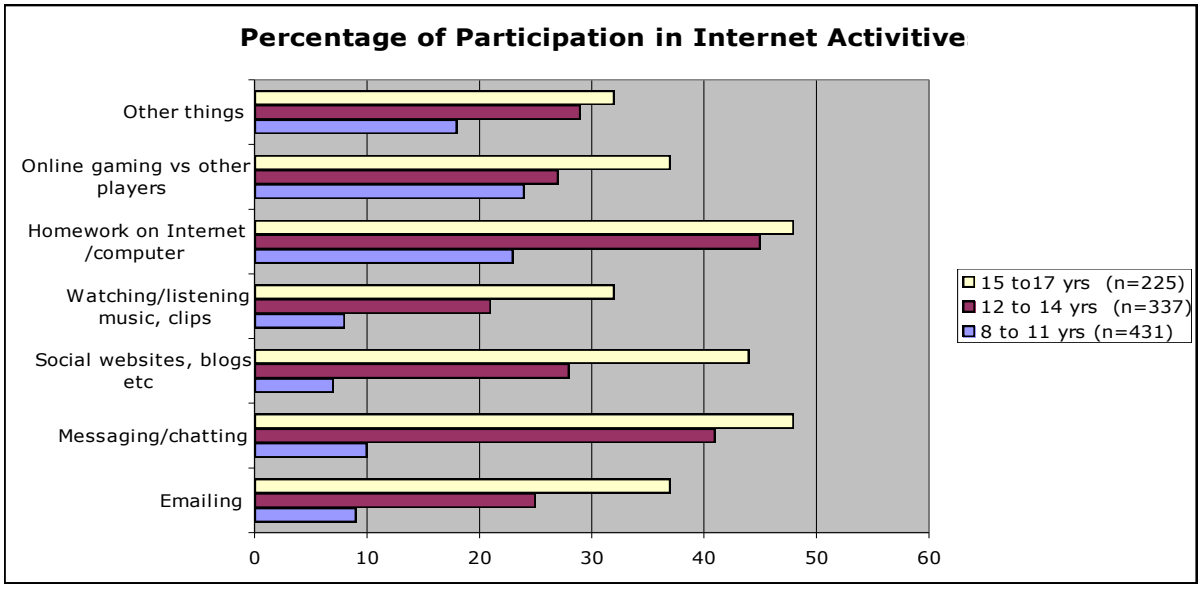
- **Digital pioneers** lead the way in the use of emerging technologies and were doing things like 'blogging' before there were even words to name these actions. This relatively small group are self-motivated, feel a sense of ownership for their purposeful, creative contributions to the cyber-world and learn rapidly through peer-to-peer exchanges. Part of their identity is established through public venues such as YouTube and MySpace, as well as through characters they develop in online 'games'.

(Based on Green & Hannon, 2007)

In 2007, the Australian Government organization, the Australian Communications and Media Authority (ACMA) published a major research report that included data gathered from the three-day diaries of 1003 children aged 8-17 years. The following graph (Figure 1) of children's Internet activities has been created from the table that appears on page 12 of the subsequent 2008 ACMA focus report on *social networking*. The average time spent online at home each day across all age groups, was one hour and 17 minutes, with the 15-17 year-olds averaging almost two hours per day (excluding homework activities). The graph shows that the time spent in social networking activities increased with age. For example, 8-11 year-olds

spent an average of three minutes per day visiting social websites and blogs (eg. My Space), compared to 15-17 years olds who averaged 24 minutes per day on such activities (ACMA, 2008).

Figure 1: *Percentage of online-time spent participating in types of Internet activities by Australian children, for each age group* (ACMA, 2008).



The social website use and 'other things' included authoring of their own web-content such as posting photos or creating personal websites or blogs, by 47% of the girls and 38% of the boys. Web authorship steadily increased from 8 years (7%) through to 14 years (72%), then stabilised (ACMA, 2008:20). In general, girls spent more time messaging and chatting (16% or an average of 9 minutes per day) than boys (11% or an average of 3 minutes). However, boys generally engaged with more online gaming (28% or an average of 22 minutes per day) compared to girls (10% or an average of 8 minutes per day) (ACMA, 2008:14).

As well as understanding the nature of ICT usage outside of school, educators need consider the implications for ICT usage inside schools. It makes sense to consult the students themselves. In research involving 4000 American middle grade students in survey and focus groups, Spires, Lee, Turner and Johnson (2008) explored technology usage in and out of school, and the students' views on academic engagement. Overall the students rated using computers and using the Internet for research as the most engaging school activities, and listening to teacher explanations and completing worksheets as the least engaging. Interestingly, the four strong themes that emerged from the focus groups were:

a) *Do you know us?* – as 'digital natives', the majority of students used a variety of technologies outside of school in "authentic, personal and social ways" and wanted their teachers to understand their preference for working in these ways;

b) *Engage us* - particularly through investigative projects using appropriate technologies;

c) *Prepare us for jobs of the future* - the students had an awareness of that technology is pervasive in most professions and wanted to develop related skills;

d) *Let's not get left behind* - the students were able to envisage many interactive and media-oriented uses of technology (beyond word processing and Internet research) that would enhance their academic productivity (Spires et. al. 2008: 506-510).

Essentially, the students wanted school to be "more like the world in which they live" by integrating their social-network based technology experiences with the school learning environment (Spires et. al. 2008: 512).

It must also be remembered that not all people have adequate access to ICT and e-learning opportunities. The recently released *Digital Futures Report* (Ewing, Thomas & Schiessl, 2008) revealed that, although it has diminished over the past few years, the 'digital divide' still exists in Australia. With figures based on the survey of 1000 households, it was found that 27% of people were not using the Internet, with the dominant underlying reasons being low levels of income, education or employment. For some children, schools may provide the only opportunity for technology-rich experiences.

The future: 2010 and beyond

Research largely examines the present or reports on the past, so how does one find 'evidence' of the future? While browsing the website of an Australian educational technology conference (*Expanding Learning Horizons,* August 2009 at http://elh2009.ning.com/) I noticed the ideas of two of the presenters, about the future of technology in schools, that seem to have foundation in existing understanding of educational technology and draw from current experiences in the field. Travis Smith (2009) believes that Australian schools have reached a critical turning point in effective technology integration, and that it is the groups of teachers he calls the '*transformers*', rather than the individual inspired teachers, who are now driving the shift from '*teaching with technology*' to '*learning with technology*'. It appears that a 'critical mass' of technology savvy teachers is being achieved in many schools and this is enabling significant shifts in educational practice that integrates ICT.

Another presenter, Janice Atkin (2009), focusing on the social impact of technologies and the importance of supporting young people without adequate access to networking technologies, presented her views on the history and future of technologies. It can be seen in the summary Table 2 below, that Atkin's eras are stunningly short and the changes in both the social impact of technology use and educational impact, amazingly fast.

The main uses of technology have rapidly become much more personalised, particularly with the development of handheld 'convergent' devices that combine all the functions that young people want, such as music, images, texting, talking and 'Googling'. The ways in which young people use these technologies shape the way they perceive themselves in social contexts, as well as shaping the ways in which they learn. It is the disharmony between learning approaches outside school and inside school that is of concern to educators when considering the future of effective school education.

Table 2: The history and future of technology. Atkin (2009)

Period	Era	Main use	Social Impact	Educational Impact
Pre 1995	Nerd	Connecting experts	Utopian life	Increased access to expert knowledge
1995-1998	Surfing	Finding information and connecting people via text	Globalisation of knowledge	Easily accessible information for experts
1999-2001	Business	Streamlining everyday transactions	Off-shoring and digital divide	Broad access to ICT assumed
2002-2004	Searching	Quick access to "right" information	Internet a need not a luxury	Decline of expert
2005-2008	User-controlled	Easy download and upload of rich content	I am the universe	Learning through creation
2009-2012	Integrated	Integration of content and relationships across devices	I am always on	Mobile learning
2013-2016	Virtual	Immersion in virtual environments	Virtual and physical life is interchangeable	Learning by immersion

As an illustration of this out-of-school learning I relate a scenario that took place around my dining table during the time I was writing this paper, involving a 14 year-old, two 18 year-olds and a 22 year-old. The trigger was a simple comment about the youngest sibling's pet guinea pig. 'Why is it called a pig?' someone asked. What followed was a rapid-fire conversation and investigation of the species, its origins, habitat, predators, relationship to the much larger South American capybara and possible links to extinct mega-fauna – all facilitated by Internet connection through an *iphone* and a wireless laptop. The content was not trivial. They collaboratively dealt with scientific classifications, converted measures and made sense of the more complex information, for example, through applying abstract facts to practical contexts: 'That means it could eat all the grass in our backyard in one day!' In less than ten minutes (before I had even cleared the dinner plates) the group had followed an investigative chain of scientific facts, explored and discounted several side-tracks and unreliable sources, joked and laughed as they personalised the information, watched two videos (one of an anaconda eating a giant capybara!) and put some key points of interest (and amusement) on *Facebook* to share with their social network. Clearly this was an example of worthwhile learning but it had little resemblance to a typical school science lesson. However, it could be argued that they drew upon some knowledge and skills gained from school and now had progressed to more independent 'adult learning' techniques. The learning was spontaneous, fast-paced, dynamic, mobile and collaborative, which appears to align with Atkin's *Integrated Era*.

To most older generation observers, accustomed to more organised and sedate access to information, the scene described above would have appeared noisy, chaotic and ineffective, but Seimens (2004, 2006) argues that learning theories developed prior to the influence of technology are no longer a sufficient basis for pedagogy. Dealing effectively with the flood of rapidly changing information requires different abilities than did dealing with a more static and less accessible body of information. Seimens proposes the theory of *Connectivism*, which is the integration of principles explored by chaos, network, complexity and self-organization theories. Learning is explained as "a process that occurs within nebulous environments of shifting core elements – not entirely under the control of the individual. Learning (defined as actionable knowledge) can reside outside of ourselves (within an organization or a database), is focused on connecting specialized information sets, and the connections that enable us to learn more are more important than our current state of knowing" (Seimens, 2004:4).

Connectivism can be defined by the following principles:

- Learning and knowledge rests in diversity of opinions.
- Learning is a process of connecting specialized nodes or information sources.
- Learning may reside in non-human appliances.
- Capacity to know more is more critical than what is currently known.
- Nurturing and maintaining connections is needed to facilitate continual learning.
- Ability to see connections between fields, ideas, and concepts is a core skill.
- Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.
- Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision". (Seimens, 2004:4)

The efficacy of such a theory of learning and its relevance to the education of children is yet to be comprehensively researched. Indeed, Bennett, Maton and Kervin (2008) caution against basing educational decisions on observation and speculation, rather than substantial empirical evidence and sound theory. However, theories that seek to capture the e-learning phenomenon are of interest to educational leaders now, and corresponding e-pedagogies are already beginning to emerge in schools, driven by the children, teachers and school leaders themselves. Elements of *connectivism* are reflected in the descriptions of Australian school projects mentioned earlier, and so perhaps the application of such learning theories in schools over the next several years is realistic. But what of Atkin's (2009) next predicted *Virtual Era*?

In her book, *Tomorrow's People*, Professor Susan Greenfield (UK neuroscientist) speculates about the extent of our immersion in virtual worlds, the impact on brain function, and the changes in our social needs and structures. She emphasises the personalisation of learning and the decline in relevance of the standard large-group classrooms that are the product of the Industrial Age.

> Schools in the Information Age will not simply be the same kind of schools that we went to with merely more computers in them! One of the most fundamental changes

> in the future … … will be in oral communication with, and personalisation of, machines. Children will grow up interacting with dozens of 'personologies' emitted from their PCs, and therefore will be comfortable communicating and socializing in the cyber-world as in the real one, perhaps even more so. (Greenfield, 2004:168)

Our brains adapt and 'rewire' according to our experiences and there is already evidence that teenagers' brains function differently as a result of their interactions with modern technologies.

> The brain is particularly plastic, impressionable, when it is developing. Early exposure to computers, hypertexting, mouse manipulation, menus and binary decisions will inevitably leave its mark on the nascent synapses … … young people have already developed thumbs as dextrous as their fingers, due to incessant playing of GameBoy and text messaging … … children are even starting to point with their thumbs! (Greenfield, 2004:168)

Conclusion

With such rapid development in the field of technology applications, the most that social and educational research can hope to do is to capture 'snapshots' of what is, and propose tentative predictions of the future. A limitation of educational research is that it investigates the present, and by the time it is published it explains past. While this may be satisfactory for aspects of education that remain relevant over relatively long periods of time (at least several years), it is inadequate for the rapidly shifting field of e-learning. Instead, planning needs to be based on well-reasoned and well-informed prediction. Even a conservative view of the impact of technology on pedagogy and on learning environments in schools must concede that a substantial portion of educational practice must embrace and harness the new technology-integrated learning approaches of young people, and strive to decrease the divide between home and school-based learning.

When compared to Atkin's eras, the data from the Way and Webb 2002-2005 study, suggests that the majority (60%) of Australian primary schools, at Category 2 in the Framework, were perhaps one or two eras behind the technology impact wave, but that the schools at Category 3/4 of the Framework (21%) were riding the crest of the wave into the future. This phenomenon supports Smith's notion that the 'tide is turning' at last in the integration of educational technology and the development of associated pedagogies.

Clearly the digital-native generation have developed ways of learning in their lives outside of school that differ from the more traditional learning modes expected inside most schools. There is growing opinion that this dislocation of learning environments may be a major contributor to the widespread disengagement of students as they move through into secondary school. Additionally, the skills that are being learned in the digital environment, particularly by 'creative producers' and 'digital pioneers' are increasingly valuable to the rapidly developing global knowledge economy, placing these young people at a distinct employment advantage over their peers who have not had similar e-learning experiences, and who lack the necessary supportive social and knowledge-sharing networks.

There exists an educational imperative, particularly from an equity point of view, for schools to adopt appropriate technology-rich curricula and pedagogies to provide *all* children

with learning opportunities that prepare them for the future. The pathway forward into the 21st Century for schools is the development of digital environments that stimulate purposeful creativity, and facilitate experiential and peer-exchange learning, with teachers having a key role in promoting critical thinking skills such as evaluating, questioning and prioritising information. The importance of schools developing social networking as learning agencies for all children must not be underestimated, as both their social and educational progress will become increasingly dependent on peer-exchange during the teenage years and early adulthood. However, neuroscience indicates that critical brain development occurs at an early age and that interaction with technologies sculpts brain configuration. A focus for primary education thus becomes the development of cognitive and social-networking skills associated with technology, rather than the teaching of specific information and the development of knowledge itself. As a consequence, curricula must become more fluid and self-determined to allow effective integration of foundation concepts and skills acquired at the primary level, such as literacy and numeracy, with the dynamic learning pathways found in technology-enabled learning environments.

If the fundamental goal of education is to prepare our children to effectively participate in and contribute to their future societies, then schools have the responsibility of engaging *all* children with appropriate technology-integrated learning environments that do not reside entirely within the physical boundaries of the school. Indeed, we must admit that virtual schools are on the horizon and develop ways to productively manage the educational opportunities rather be separated from them.

References

Atkin, J. (2009). *The social impact of technology*. Presentation at the Expanding Learning Horizons Conference, August 2009. http://elh2009.ning.com/ [viewed 3 September 2009]

Australian Communications and Media Authority (ACMA). (2007). Media and Communications in Australian Families: Report of the Media and Society Research Project. http://www.acma.gov.au/WEB/STANDARD/pc=PC_310893. [Retrieved 2 September 2009]

Australian Communications and Media Authority (ACMA). (2008). *Internet use and social networking by young people.* http://www.acma.gov.au/WEB/STANDARD/pc=PC_311396

Bennett, S., Maton, K. & Kervin, L. (2008). The 'digital natives' debate: A critical review of the evidence. British Journal of Educational Technology, 39(5), 775-786.

Ewing, S., Thomas, J. & Schiessl, J. (2008). *CCi Digital Futures Report: The Internet in Australia*. Australian Research Council Centre of Excellence for Creative Industries and Innovation. Available online at: www.cci.edu.au/projects/digital-futures. [Retrieved 2 September 2009]

Green & Hannon, (2007). *Their Space*: *Education for the digital generation*. London: DEMOS. Online at www.demos.co.uk [retrieved 9 July 2009]

Greenfield, S. (2004). *Tomorrow's People: How 21st-Century Technology is Changing the Way we Think and Feel.* London: Penguin.

Prensky, M. (2007). Changing paradigms. *Educational Technology*, July-Aug, 2007 http://www.marcprensky.com/writing/Prensky-ChangingParadigms-01-EdTech.pdf [viewed 20 March 2008]

Siemens, G. (2004). Connectivism: A learning theory for the digital age. *Elearnspace*. Online at http://www.elearnspace.org/Articles/connectivism.htm. [viewed 3 March 2008].

Seimens, G. (2006). Connectivism: Learning and Knowledge Today. Paper presented at *Global Summit 2006: Technology Connected Futures,* October, Sydney Australia. http://www.educationau.edu.au/jahia/Jahia/pid/305 [viewed 19 August 2008].

Smith, T. (2009). *Full on collaborative learning*. Presentation at the Expanding Learning Horizons Conference, August 2009. http://elh2009.ning.com/ [viewed 3 September 2009]

Spires, H., Lee, J., Turner, K. & Johnson, J. (2008). Having our say: Middle grade student perspectives on school, technologies and academic engagement. *Journal of Research on Technology in Education*, 40(4), 497-515.

Way, J. (2009). E-pedagogy in Australian primary schools. In L. Tan Wee Hin & Subramaniam (Eds.) *Handbook of Research on New Media Literacy at the K-12 Level: Issues and Challenges.* IGI Global: Hershey, USA. (pp. 588-606)

Way, J. & Webb, C. (2007). A framework for analysing ICT adoption in Australian primary schools. *Australian Journal for Educational Technology*, 23(4), 559-582.

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