Using ICTs to Cater for Individual Learning Styles

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"The principal goal of education in the schools should be creating men [and women] who are capable of doing new things, not simply repeating what other generations have done; men [and women] who are creative, inventive and discoverers" (Jean Piaget cited in Pulaski 1971:200).

1. Abstract

The high uptake of Information & Communication Technologies (ICTs) by young people and the pervasiveness of a digital culture in our society are well documented. This culture differs from a previous media culture (based primarily on analogue technologies e.g broadcast radio, television and print-based texts) in that it offers learners many opportunities to create digital texts for real audiences and to collaborate and share ideas with others in a global network.

ICTs and the wider digital culture are having a deep impact on schooling in that teachers should be re-conceptualising notions of curriculum and should be re-thinking pedagogies. Together with an increasing emphasis on constructivist learning environments and a deepened understanding of the nature of human intelligence in the last few decades, teachers are developing educational practices that support and enhance learning and that cater for individual differences in student-centred learning environments.

ICTs are also giving educators the opportunity to explore how curriculum can be viewed from the perspective of multiple intelligences with multimedia applications stimulating individual learning preferences which have been ignored in traditional educational practices.

This paper examines how ICTs can be used as tools to accommodate individual learning styles. It advances the notion of differentiated curriculum by focusing on the following:

- The relationship between the demographic group referred to as millennials (Howe and Strauss 2000) and ICTs and their implications for classroom practice
- The relationship between digital culture and the traditional culture of schooling
- The relationship between Howard Gardner's theory of multiple intelligences (1983, 1999) and ICTs
- The ways in which new internet technologies (in particular, learning management systems, podcasts, weblogs and wikis) can be used to address multiple intelligences
- The planning of lessons involving multiple intelligences and ICTs.

2. Demographics and Digital Culture – Who Are We Teaching in Our Schools?

Discussions of the integration of ICTs in schools should be prefaced with an understanding of the demographics of our classrooms and the wider culture in which schools exist. Howe and Strauss (2000), in their seminal book <u>Millennials Rising: The Next Great Generation</u>, coin the term 'millennials' to describe a generation of young people who were born between 1982–2002. This group follows previous generations including Builders (1925-1942), Boomers (1943-1960) and Generation X (1961-1981).

It is widely accepted that the attitudes and values of young people today differ to those of previous generations. This is largely due to changing cultural, social and political contexts (Howe and Strauss:2000; McCrindle:2004; Tapscott:1998). In particular, "Generation Y's have lived through the age of the internet, cable television, globalization, September 11, and environmentalism" (McCrindle 2004:2).

Howe and Strauss (2000) state that because millennials are confident, adept at using technology and are focused on achieving in their studies, they will become one of the most influential generations. Frand (2000) states that millennials have grown up with an information-age mindset. Integral to this are the following values - that computers are not considered to be technology (but rather a natural part of life), the internet is better than TV, multitasking (doing several tasks at the same time) is a way of life and staying connected to others through the use of technologies is essential (Frand:2000).

Further to this, Jonas-Dwyer and Pospisil (2004), Oblinger (2003) and McCrindle (2004) point out that it is imperative for educators to understand the mindset of this generation. This includes an understanding of the following learning preferences:

- The need to be socially connected
- A preference for experiencing (rather than simply listening to what teachers say).

Jonas-Dwyer and Pospisil (2004), in their study of students in Australian universities, assert that millennials display learning preferences that emphasise collaboration, hands-on experience and the use of technology to communicate with peers. They state that "email and instant messaging are natural communication and socialisation mechanisms for teenagers today" (Jonas-Dwyer and Pospisil 2004:195).

These preferences challenge the way teachers have traditionally communicated to students in classrooms (i.e. 'talk and chalk'). As McCrindle states:

> *"The traditional talk and chalk won't work with this generation. Our communication style is structured, yet they want freedom. We stress learning, they like experiencing. We react, they relate. We focus on the individual, while they are socially driven"* (McCrindle 2004:4).

Jukes, Dosaj and MacDonald in their work on information literacy suggest that there is a fundamental disjuncture between the way kids think, learn, and communicate and the ways that schools interact with them. In particular they conclude that

> "students live, breathe, and play in the real world that exists outside of education, and they bring an immediacy of that world into their classrooms. The more archaic and disconnected the curriculum becomes, the more disengaged students become from what and how they learn" (Jukes, Dosaj & MacDonald 2000:107).

What is suggested here is not only an understanding of generational attitudes, beliefs, communication and values but also an understanding of preferred learning environments. Prensky (2001) argues that because today's students are surrounded by an ubiquitous digital environment, they "think and process information fundamentally differently from their predecessors" (Prensky 2001:1). However the majority of schools are currently designed to deliver curriculum in a manner preferred by past generations.

In many classrooms the learning preferences and needs of today's students are not accommodated.

In these environments, "digital immigrants" (Prensky 2001), the educators for whom technology is an adopted (second) language are educating their students, "digital natives" (Prensky 2001) for whom technology is a first language.

3. Changing Media, Literacies and Pedagogy

To further understand the preference for the use of technology by today's students it is also important to understand the fundamental differences between analogue and digital media. Analogue media (e.g. free-to-air television, radio, film, textbooks) are linear texts which provide the reader with limited active interaction. On the other hand the new digital media and technologies are non-linear with multiple pathways and significant interaction built in for the user. Tapscott (1998) states:

> *"To the digital savvy N-Geners, television should be interactive….This shift from broadcast to interactive is the cornerstone of the N-Generation"* (Tapscott 1998: 2-3).

In a wider sense, the notion of authorship also differs within analogue and digital cultures. Past generations consumed texts within a dominant print culture where there were barriers to authorship and hence few authors. However in a digital environment, new technologies give us greater opportunities to create as well as consume or read texts. In a digital environment culture there are multiple authors. One only has to look at the multiple authorship and interactivity that is conventional in the reality television genre that has become popular over the last few years. Programs such as *Australian Idol* and *Big Brother* encourage viewers, through the use of ICTs (e.g. digital video cameras, mobile phones and websites), to create content that is built into the program structure.

This also signifies a cultural shift from a broadcast model where information is communicated to mass audiences to a network model where different individuals, technologies, texts are linked together to communicate understandings and to collaborate and create new forms of knowledge. Castells (1996) contends in his influential book The Rise of the Network Society that within media culture (and in our society) networking is the new dominant paradigm. As Castells states:

> *"As a historical trend, dominant functions and processes in the information age are increasingly organized around networks. Networks constitute the new social morphology of our societies, and the diffusion of networking logic substantially modifies the operation and outcomes in processes of production, experience, power, and culture. While the networking form of social organization has existed in other times and spaces, the new information technology paradigm provides the material basis for its pervasive expansion throughout the entire social structure"* (Castells 1996:500).

However learning environments need to reflect the wider digital (network) culture. Traditionally learning in schools has reflected the broadcast ('one size fits all') model where there are limited opportunities for authorship. In this case the teacher transmits information and knowledge to all students regardless of ability. Work produced by students is generally for the teacher and not shared with other individuals. However to

accommodate different individual learners, schools and teachers need to explore the impact of the wider digital culture.

Dixon (2001) takes this further by stating that educators need to focus on "re-engineering" practices in schools so that they are relevant to the attributes and skills required in a knowledge-based society. This necessitates a paradigm shift in the way curriculum is conceptualised. In particular, curriculum needs to be viewed in terms of a networking of multiple pathways which are facilitated by ICTs that contest the transmission of knowledge in a traditional (linear) model.

Part of the re-engineering of curriculum includes re-worked notions of critical literacy. The construction of texts within a network paradigm necessitates different ways of reading. Whereas texts published within a print culture demand reading in a linear form, the multimodal and interactive texts produced and shared with a networked audience (e.g. via the internet) use a variety of codes and are hyperlinked to various other texts. Hence the texts produced in a digital culture rely on notions of hybridity and intertextuality (Luke 2000:73). As Luke states:

> *"Meaning-making from the multiple linguistic, audio, and symbolic visual graphics of hypertext means that the cyberspace navigator must draw on a range of knowledges about traditional and newly blended genres or representational conventions, cultural and symbolic codes, as well as linguistically coded and software-driven meanings" (Luke 2000:73).*

The interactive capabilities of ICTs, the positioning of schools within a wider digital culture and the 're-engineering' of curriculum and critical literacy in a knowledge society that is characterised by multiple pathways, work to prioritise the notion of a differentiated curriculum. Such a curriculum "relates to understanding individual differences and devising institutional strategies to cater for students' needs" (NSW Department of Education and Training 2004: 6). ICTs are pertinent here as these tools promote critical pedagogies that encourage students to collaborate with others and to author new concepts and ideas (knowledge) which are structured as multi-modal texts to be shared with real audiences. In other words, ICTs provide learners with greater opportunities to assume individual ownership of multiple pathways in the learning process and to construct, display and publish their own knowledge and understanding. As Luke comments,

> *"The ability to import, download, drop and drag text and imagery……creates new skills, processes and multimodal forms of 'textual' production that encourage interdisciplinarity, creativity and imagination, collaborative authorship, editing, reading and writing, and problem-based learning" (Luke 2000:87).*

4. Constructivism and ICTs

The emphasis on creating texts within a digital culture and the notion of a differentiated curriculum are also aligned to the philosophical underpinnings of constructivism. As a learning theory constructivism evolved from cognitive learning theory and has been increasingly aligned to the work of Bruner, Dewey and Vygotsky (Roblyer:2003). It puts forward the idea that learners actively construct their own knowledge and understanding of the world. The construction of knowledge is influenced by the learner's past experiences and understanding of the world. Within this paradigm, knowledge is not

absolute as it is individually constructed by learners and is based on their own interpretations of the world.

The idea of constructivism as a philosophical approach to learning is evident in the findings of the social researchers and writers mentioned above. McCrindle (2004), Prensky (2000) and Tapscott (1998) state that today's students value learning which is based on experience and which encourages social interaction. Further to this, these values are complemented by the belief that knowledge and truth are relative and not absolute (as was the belief with previous generational groups). As McCrindle states

> *"the concept of absolute and inherent truth has been banished as truth is deemed to be relative to one's own backyard and understanding" (McCrindle 2004:3).*

Such an assertion opposes the concept of instructionism which is grounded primarily in behaviourist learning theory e.g. Skinner, Gagne (Roblyer:2003) which dominated the modes of learning promoted in schools throughout the 20th century. As a theory instructionism puts forward the idea that learning occurs when knowledge is transmitted to people and that knowledge is seen as having a separate existence outside of learners.

Complementing the idea that knowledge is constructed by learners, constructivist theorists share the beliefs that:

- Learning should be seen as a social activity
- Learning should be relevant to the real world.

As an example Dewey (1916) promoted the concept of social constructivism. He believed that constructivist learning should:

- begin with students' interests (learning that is student-centred)
- emphasise a connection to the real world
- be hands-on and experience based.

ICTs are well suited to the ideas of constructivism. Put simply, ICTs provide the tools that allow learners to construct their understandings of the world. Further to this, the constructivist approach with the use of ICTs has removed the notion of the teacher as the gatekeeper of information and replaced it with the notion of students accessing information independently and directing their own learning. Hence the role of teachers must change from instructors/transmitters of knowledge to facilitators (expert learners) in the learning process.

The development of new internet technologies over the last few years is aligned with Dewey's (1916) notion of social constructivism and further emphasises the network model mentioned above. 3G mobile phones, blogs, GPS devices, podcasts, RSS aggregators, VoIP and wikis are some examples of how the internet allows access to network applications which are used to create texts as well as collaborate, communicate and share information and knowledge.

These developments are also consistent with original intentions stated by Tim Berners-Lee, the founder of the World Wide Web. As Berners-Lee (1995) stated:

> "I had (and still have) a dream that the web could be less of a television channel and more of an interactive sea of shared knowledge." (http://www.elon.edu/predictions/tim_berners_lee.aspx Accessed 21 September 2005).

Schneiderman (2003) suggests that there should be a greater emphasis within education on creative uses of the internet rather than using the internet as a resource. Implicitly learners should be encouraged to function as active creators of knowledge and not as passive consumers. As Schneiderman states

> "the World Wide Web.......cannot be a solution to educational needs unless the creative component is included. We have to do more than teach kids to surf the Net; we have to teach them to make waves. Finding Web resources is fine; creating new ones is the key to the new education" (Schneiderman 2003:118).

Schneiderman's (2003) assertion is aligned with Dewey's (1916) philosophy of social constructivism. Although Dewey's (1916) published work and beliefs about learning were considered radical in the early 20th century, this author suspects that he would be well pleased with the capabilities of the new technologies of the early 21st century. In particular, the increased capabilities in new internet technologies for students to communicate and collaborate with each other and to construct knowledge about their world appears to be well suited to his philosophy of learning and the ideas put forward by other constructivists.

5. Gardner's Multiple Intelligences and ICTs

Howard Gardner's (1983, 1999) theory of multiple intelligences differs to other learning and developmental theorists in that his work attempts to define the role of intelligence in learning. Gardner contends that the notion of intelligence in western civilisation is influenced by cultural factors. In particular, intelligence in western civilisation is culturally biased towards the verbal-linguistic and logical-mathematical intelligences. However, as mentioned above, cultural influences are changing as our society places greater value on other intelligences.

Hence Gardner's theory challenges pre-conceived and prevailing definitions of intelligences and 'what it means to be smart'. He briefly outlines these intelligences as follows:

Verbal-Linguistic intelligence (focuses on the capacity to use written and verbal language to express oneself and understand others)
Logical-Mathematical intelligence (the capacity to manipulate numbers and operations and to understand underlyling principles and structures of systems)
Visual-Spatial intelligence (the capacity to think in 'pictures' and then represent one's thinking to others)
Musical-Rhythmic intelligence (the capacity to recognize patterns, rhythms and other auditory expression (not only in music) and to manipulate them)
Bodily-Kinesthetic intelligence (the capacity to use the body to solve problems, manipulate and control objects and to express oneself)

Interpersonal intelligence (the capacity to learn through social interaction with others e.g. discussion and collaborative work)

Intrapersonal intelligence (the capacity to understand oneself and to learn through metacognitive practices e.g. reflection

Naturalist intelligence (the capacity to learn through interactions with the environment and through sensitivity to nature).

Gardner states that everyone possesses these intelligences in different degrees so that they are not exclusive. In other words, learning is expressed as a combination of these intelligences. Further to this, Gardner points out that learners have different ways of representing meaning and no two learners possess the same profile of intelligences.

The theory of multiple intelligences challenges the teaching practices which have traditionally occurred in schools. The bias towards language and logic in our culture is also reflected in our schools. Traditional practices have not always promoted other ways of representing meaning and understanding – the visual, the kinesthetic, the musical, the intrapersonal and interpersonal. If Gardner's theory is correct then our traditional curriculum has not always promoted full intellectual growth because it has allowed learners to follow limited pathways to display intelligence and to attain significant levels of achievement. This is because the learning pathways that suit various learners and the wider culture are not valued in the framework of traditional schooling. As Gardner states, intelligence is "the ability to solve problems and create products that are of value within one or more cultural settings" (Gardner: 1999:33).

The emphasis on multiple learning paths again raises the relevance of the notion of differentiated curriculum. Gardner's focus on individual learners (and not homogenous groups of students) is well suited here as he re-frames the question that is often asked by teachers *'How smart are our students?'* to *'How are our students smart?'* This assumes that teachers need to design learning experiences and tasks that allow students to represent meaning and understanding in various ways.

The deployment of ICTs as learning tools is useful as a way of providing a variety of learning paths in a differentiated curriculum (see Appendix A). This is largely due to the facilities provided within new technologies that allow learners to author and express concepts and ideas in various contexts and genres. Further, ICTs provide learners with multiple avenues to display their knowledge and understanding that have not always been available within a traditional curriculum.

Gardner (1999) supports the use of educational technology as a way of enhancing programs that endorse a multiple intelligences' approach which allows for individulalised learning. While he does not suggest that technology should drive curriculum design and the formulation of educational goals, Gardner sees the potential for individualised learning "to be enhanced significantly by technology" (Gardner 1999: 179). Further to this he states that

> *It is not easy for teachers to provide individualized curricula and pedagogy…...Happily, we have in our grasp today technology that should allow a quantum leap in the delivery of individualized services for both students and teachers……that addresses the different intelligences (and) that allows students to exhibit their own understandings in diverse symbol systems (linguistic, numerical, musical, graphic, and more)* (Gardner 1999:179).

6. Using the Internet to Cater for Different Learners – New Possibilities

As mentioned previously, the development of new internet technologies, and in particular the development of Web 2.0, have seen a change from the web as a medium to access information to a networked platform that encourages collaboration and interactivity between applications and users. Roush (2005) states that the multi-faceted nature of the internet is due to "the emergence of the web as a platform for personal publishing and social software" (Roush 2005:49). Examples of this are websites with links to multimodal texts (e.g. virtual tours, video and audio), informational websites that encourage the sharing of content and networking such as blogs and wikis, websites that allow users to categorise and 'tag' uploaded data (e.g. 'tagging' uploaded photos on www.flickr.com, finding data that has been 'tagged' by other users on www.technorati.com), a growing space for open source applications to be developed and social software applications such as GPS receivers, PDAs and 3G mobile phones.

As ICT leaders in our schools, we need to constantly scan the horizon to plan for the future integration of developing technologies in curriculum practices. While it is difficult to predict the future, one trend that is certainly noticeable is the continuing development of the internet as a social medium and as a product of our social environment (Barr, Burns, Sharp:2005). This is also reshaping the learning styles of students. Dede (2005) suggests that the learning styles of 'neomillennial' learners will be based on 'mediated immersion' in multiuser virtual environments. This will mean an ICT literacy that further emphasises fluency in multimedia virtual environments, communal learning distributed across growing network infrastructure and non-linear media forms.

The author believes that the new internet technologies developed and marketed over the last few years offer potential in the ways they can be used to assist students with achieving learning outcomes. McKenzie (2005) outlines in the table below how "the internet is the most robust medium for addressing all the intelligences" (McKenzie 2005: 131):

Internet Technologies	
Technologies	**Intelligences**
Electronic Mail (email)	verbal interpersonal
Mailing Lists	verbal logical interpersonal
Message Boards	verbal logical interpersonal naturalist
Chats	verbal visual interpersonal naturalist existentialist
Multiuser Virtual Environments (MUVEs)	verbal logical visual

	kinesthetic
	interpersonal
	intrapersonal
	naturalist
	existentialist
World Wide Web (WWW)	verbal
	logical
	visual
	musical
	kinesthetic
	interpersonal
	intrapersonal
	naturalist
	existentialist

6.1 Some New Ways of Learning from the Web: Wikis, Weblogs, Podcasts and Web Quests

In using the World Wide Web in learning environments, one could add new technologies such as podcasts, wikis and weblogs and activities such as web quests as useful resources that can used to address a multiple intelligences' approach to curriculum delivery.

(a) Wikis

A wiki is a free online encyclopedia which is best described as a collaborative environment that allows learners to share knowledge by allowing learners to add content on the wikipedia website (http://www.wikipedia.org) as well as to edit existing content.

Further to this, learners are able to build and visit wikicities (http://www.wikicities.com) best described as communities with a collection of web pages which can be edited by users.

Other wiki sites that are available in the public domain for adding and/or editing content include the following:

- Wikitext (http://wikitextbook.co.uk) - textbooks for different subject areas
- Wikinews (http://en.wikinews.org) – news content
- Wiktionary (http://en.wiktionary.org) – a collaborative multilingual dictionary
- Wikibooks (http://en.wikibooks.org/) – a collection of open-content books
- Wikiquote (http://en.wikiquote.org) – an online collection of quotations
- Wikisource (http://en.wikisource.org) – a repository of primary source texts
- Wikispecies (http://species.wikipedia.org) – an open online directory of species
- Wikipedia Commons (http://commons.wikimedia.org) - a repository for images (e.g. animation, paintings, photos), music, sound & video clips
- Wikitravel (http://wikitravel.org) – travel guide of worldwide destinations.

Some useful Australian wikis include the following:

- Australian National University – Faculty of Asian Studies (http://asianstudies.anu.edu.au/wiki)
- Geocaching Australia (http://wiki.geocaching.com.au/wiki).

While the emphasis on 'sharing' knowledge with others via wikis addresses the interpersonal intelligence, the application of wikis in a learning environment also has the potential to assist with research and create written content (verbal-linguistic), to create and upload images (visual-spatial) and to access and create audio (musical-rhythmic).

(b) Weblogs

Weblogs (commonly known as 'blogs) have become increasingly popular. They allow users to publish content to personal websites and are generally written in the form of a diary or journal.

Blogging has become mainstream following its success in presenting eye-witness accounts during the war in Iraq and as a tool in promoting political candidates (e.g. Howard Dean's attempt to be elected as the Democratic candidate during the 2004 Presidential elections) and in covering political events. More recently, blogging has raised new questions about citizen journalism given that major news outlets sometimes rely on blogs for content. The popularity of blogs is also evident in the competition between search engines (e.g. Google & MSN) to provide users with easy access to blog creation tools and with the convergence with other technologies (e.g. the use of mobile phones for moblogging).

Like wikis, blogs are a new space within cyberspace. They give users opportunities to share ideas and thoughts. So pervasive is "blogging that it has become a social force in its own right generating its own lexicon: the'blogosphere' (the blog ecosystem) (Barr, Burns and Sharp: 2005).

Within an educational context, blogging is a tool with not only the potential for sharing ideas and collaboration but also for reflection of events, issues and processes. The greater emphasis placed on the learning process in student-centred environments (as put forward by constructivists) gives learners greater opportunity to reflect on their own thinking and decision making. This form of metacognition is particularly evident in subject areas where student journals are an integral part of the learning process. Hence blogs are not only social networking tools (interpersonal intelligence) but can also be used to address what Gardner refers to as intrapersonal intelligence.

Blogs also have links to syndicated RSS (XML) feeds. RSS is an abbreviation for Rich Site Summary or Really Simple Syndication. In simple terms it is commonly referred to as a 'feed' to news headlines, summaries of news content, authors and other blogs that are accessed by RSS readers or aggregators. One example is *bloglines* (http://www.bloglines.com) which allows users to access content updates from various sources on a regular basis. Learners may use this tool to follow the development of a particular event and/or issue and to follow commentary from various authors, blogs and news sources. Hence RSS can be used as a useful research tool (verbal-linguistic), as a tool to organise content and to assist with making conclusions (logical-mathematical) and as a social networking tool (interpersonal intelligence).

(c) Podcasting

Put simply, podcasting refers to the publishing of audio programs on the internet that can be downloaded to computers and/or portable audio players. The word 'podcasting' is a combination of 'broadcasting' and 'iPod'. However this is misleading as an iPod is not required to access a podcast.

Learners (and educational institutions) are able to access podcasts by subscribing to RSS feeds that are available on websites. Some useful podcasts that can be used as learning resources include the following:

- Australian Broadcating Corporation (http://www.abc.net.au/services/podcasting.htm)
- Special Broadcasting Service (http://www20.sbs.com.au/podcasting/)
- Podacsting News (http://www.podcastingnews.com/forum/links.php)
- Podcast Alley (http://www.podcastalley.com).

Further to this, podcasting allows learners to produce audio programs that can be published online. This can be done by using free audio software (e.g. Audacity at http://audacity.sourceforge.net/).

The Apple iPod (and other portable audio players) is best known for downloading music files to .mp3 or AAC (Apple iTunes) format. As a result, there is sometimes a negative discourse surrounding the use of iPods as some teachers see this technology as a distraction to effective learning. This viewpoint fails to recognize the potential of the iPod as a learning tool. Such a viewpoint ignores the capacity to store photos and podcasts as well as music.

A voice recorder can also be used to record voice onto the iPod. This can be used by learners to record observations and thoughts during learning activities. Further to this the recorded voice can be imported into audio recording software (e.g. Audacity) and mixed with other audio tracks (e.g. music) to create audio programs (podcasts).

Below are some specific examples of how iPods and audio recording/editing software can be used to address multiple intelligences:

iPods/Podcasts & Multiple Intelligences	
Learning Experiences	**Multiple Intelligences**
(a) Teachers	
Record lessons to be accessed by teachers at a later time	verbal-linguistic
Import a podcast and publish for student access	verbal-linguistic
(b) Students	
Record oral histories or interviews	verbal-linguistic, interpersonal
Record a conversation in a foreign language	verbal-linguistic, interpersonal
2 or 3 students create a podcast and publish online on the school intranet	verbal-linguistic, interpersonal, musical-rhythmical
Record observations and thoughts during a	verbal-linguistic, intrapersonal

field trip/school excursion	
Record observations and thoughts during a nature walk	verbal-linguistic, intrapersonal
Export photos from a school excursion to an iPod. Write personal reflections on these photos	verbal-linguistic, visual-spatial, intrapersonal

(d) Web Quests

Web Quests have become popular in recent years. They are described as inquiry-orientated tasks that provide learners with hyperlinks to internet resources. Completing the task, learners are required to assume one of several roles in order to solve a problem. This means that learners are required to assess a problem from a particular perspective, then collaborate with other learners who have assumed different roles in order to solve the problem. McKenzie (2005) suggests that the diversity of roles in web quests is a useful way for teachers to design tasks that address multiple intelligences.

As a simple example, a web quest that focuses on environmental problems may be studied from the perspectives of a concerned citizen, an environmentalist, a property developer and a scientist. The richness of such tasks lends itself to addressing multiple intelligences.

A more specific example is the web quest created by Tim Baldwin, a teacher of History at Marist College Ashgrove. Focusing on the Treaty of Versailles, this web quest (http://www.kn.sbc.com/wired/fil/pages/webtreatyomr.html) asks students to determine the success or failure of this historical event. In doing so, students are required to assume the role of one of the key historical figures (e.g. Lloyd George, Vittorio Emmanuele Orlando, Woodrow Wilson) and to 'attend' a dinner party during the Treaty of Versailles conference. The construction of this activity challenges students to research and write about the role they assume (verbal-linguistic intelligence), to collaborate with others (interpersonal intelligence) and to role play (bodily-kinesthetic and musical-rhythmic intelligences).

6.2 Using Learning Management Systems to Deliver Individualised Curricula

The delivery of curriculum materials in online environments which are customised for individual learners is becoming increasingly popular. The obvious benefit here is that students are able to access materials without the restrictions of time and place. In order to manage the increasing amount of data here, educational institutions are deploying learning management systems. For example, Blackboard (http://www.blackboard.com/) and Web CT (http://www.webct.com/) are probably the most popular systems used in tertiary institutions in Australia.

These systems commonly provide students with access to email, discussion groups, chat rooms, real-time white boards and results for submitted work. Educators are usually provided with facilities to develop course/subject web pages with hyperlinks to learning materials and other important information e.g. announcements and a calendar of dates. (An independent review of various learning management systems can be accessed at http://www.edutools.info/)

One of the major benefits here is the facility to customise information which is relevant to different individuals in the same educational institution. One example of this is the eduKate Learning Management System (http://www.edukate.com) which has been implemented at Marist College Ashgrove in 2005. This system is tightly integrated with the College's database (TASS). Hence when an individual teacher or an individual student logs onto eduKate at any time or in any place, s/he will find information customised to their own timetable.

Further, teachers are able to assign different materials to different learners depending on their abilities, interests and needs. In this context, teachers have a tool that allows them to deliver learning resources (commonly referred to as learning objects) which cater for multiple intelligences. As an example, a teacher of Science could post the following resources:

- Images
- Relevant URLs
- Video clips
- Virtual tours
- Audio
- Text based documents (e.g. primary resources).

S67:1 Resources
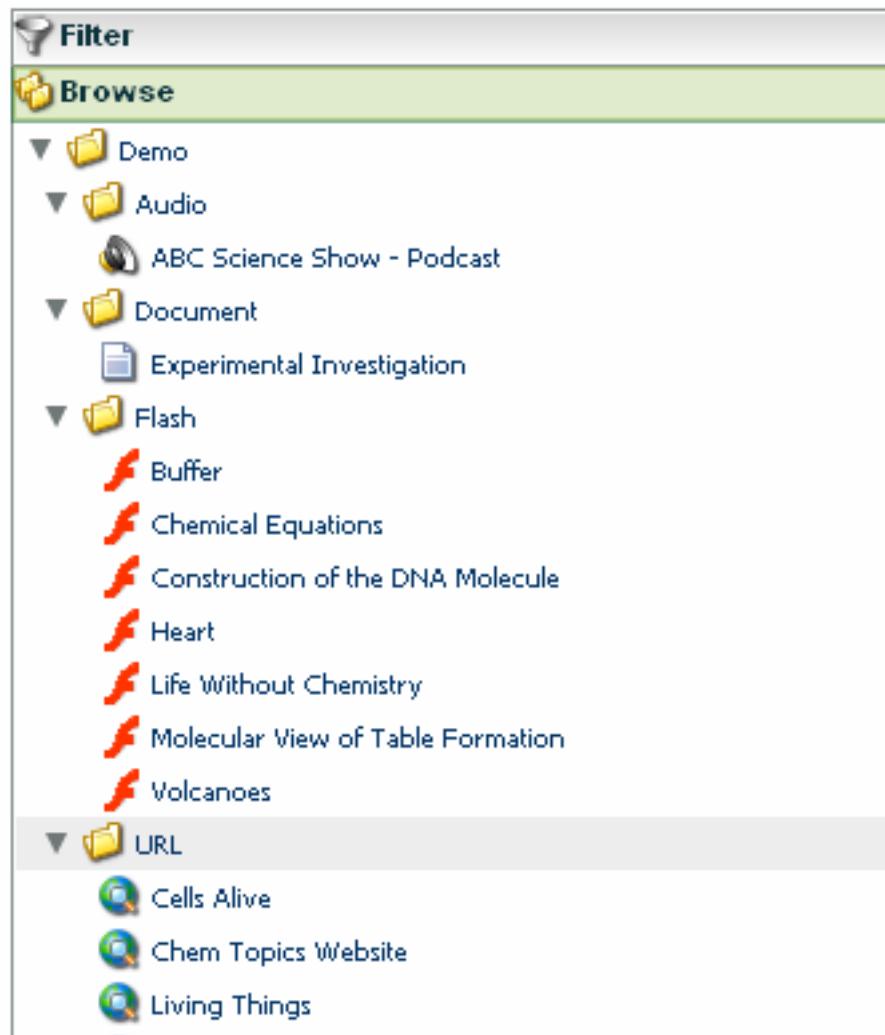
- Filter
- Browse
  - ▼ Demo
    - ▼ Audio
      - ABC Science Show - Podcast
    - ▼ Document
      - Experimental Investigation
    - ▼ Flash
      - Buffer
      - Chemical Equations
      - Construction of the DNA Molecule
      - Heart
      - Life Without Chemistry
      - Molecular View of Table Formation
      - Volcanoes
    - ▼ URL
      - Cells Alive
      - Chem Topics Website
      - Living Things

It is important to emphasise here that resources (learning objects) on their own do not enhance learning. Teachers need to create contexts which facilitate learning e.g. design a problem-solving task which demands the use of these resources as references.

Other features of eduKate and other learning management systems are the collaboration tools. In particular, students are able to send email to their teachers and/or other class members as well as contribute to class forums and discussions, real time chat and video conferencing.

Hence this technology gives teachers the opportunity to create rich, real and relevant learning environments and more importantly, enables teachers to create environments that appeal to multiple intelligences within a student cohort and to customise learning to suit different learners. This marks a shift from traditional learning environments which suit verbal-linguistic intelligence to an environment which attempts to cater for multiple intelligences. For example, the use of images and video clips may suit learners who

prefer to think visually, an audio clip may suit the musical-rhythmic intelligence and the collaboration tools may suit the interpersonal intelligence.

7. Putting it All Together - Unit/Lesson Planning

While this paper has focused in part on possible links between ICTs and curriculum, it has been the author's experience as a designer and presenter of professional development for teachers that sometimes one loses sight of the role of technology in the learning process. This is because sometimes technology is unintentionally viewed as an end in itself. However as all teachers will attest, ICTs are only tools which help to engage learners and to facilitate learning. Real learning is the result of sound pedagogical practices.

With this in mind, it is critical that teachers do not lose sight of the learner and intended learning objectives and outcomes. It is the curriculum which drives the technology. Hence McKenzie (2005) in the diagram below suggests that the planning of units and lessons should always begin with the individual learner before being followed by a consideration of learning objectives. Once these are determined, teachers should give consideration as to which of the nine intelligences will stimulate learning. Finally it is the selection of technology (i.e. which technologies best accommodate the selection of multiple intelligences) that teachers should consider.

Learners > Objective > Intelligences > Technology

taken from McKenzie W (2005:48)

8. Conclusion

Demographic changes and new digital technologies have created a new culture of authorship, individual expression and learning preferences as well as new forms of social collaboration which were not valued in print (analogue) cultures. Yet our schools are traditionally influenced by practices and resources that reflect the characteristics of a print (analogue) culture. This has presented the significant challenge of re-conceptualising notions of curriculum and schooling that are better suited to learners in the 21st century. While the integration of ICTs is now a high priority within schools, it is imperative that educators and ICT curriculum leaders explore extensively how technology can be deployed within a new cultural framework. This challenge is essentially the design of differentiated curriculum that promotes a constructivist approach to learning and that also values the needs of diverse learners and multiple intelligences.

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APPENDIX A – ICTs AND MULTIPLE INTELLIGENCES: SOME POSSIBLE CLASS ACTIVITIES

Intelligence	Technology (hardware & software)	Possible Class Activities
Verbal Linguistic	Desktop Publishing Tools (Publisher, Pagemaker)	Writing text for brochures, magazine advertisements, flyers, catalogues, signs, postcards, greeting cards, menus, resumes
	Web Development Tools (e.g. Microsoft FrontPage, Macromedia Dreamweaver, Adobe Go Live)	• Developing/writing text for a website that sells a product and/or idea and targets a specific audience • Publishing/celebrating student writing on the school intranet and/or internet
	Word Processing (Word)	• Writing, rewriting, process writing • Brainstorming, writing ideas • Journal writing • Creating a class newspaper
	Presentation Tools (e.g. PowerPoint)	• Oral presentations to the class • Teaching a lesson to the class
	Audio recording software (e.g. Audacity http://audacity.sourceforge.net/)	Recording interviews and oral histories
	Internet Collaboration Tools (e.g. email, discussion/mailing lists and forums, chat)	• Discussing, debating • Contributing to an online forum debating a topic covered in class
	Reference tools (online encyclopedias, dictionaries, CD-ROMs, e-books)	Researching an issue/topic
	Inspiration and Kidspiration	• Brainstorming, mind mapping, creating concept maps
	Digital Still Camera & Microsoft Photo Story	Creating a photo/visual montage representing an idea and/or issue. Scripting and recording a narration.
	Digital Video Cameras	• Writing a video script • Telling a storytelling

		• Interviewing
		• Producing a news program or documentary
		• Speaking, debating, dramatising
	Wikipedia	Writing a summary of the exploration of a topic/issue then uploading this to wikipedia (http://wikipedia.org)
	RSS Aggregator (free RSS aggregator at http://www.bloglines.com)	Researching the latest developments in a topic or issue that is current in the media
	Google News Alerts	Researching the latest developments in a topic or issue that is current in the media
	Crossword Puzzle Maker http://puzzlemaker.school.discovery.com/	Creating crossword puzzles
Logical-Mathematical	Spreadsheets (e.g. Excel)	• Data analysis • Calculating formulae to synthesise large volumes of data • Creating graphs to summarise data collection and make conclusions
	Presentation Tools (e.g. PowerPoint)	• Presenting results of data analysis • Teaching the class how to follow a procedure (e.g. using a calculator)
	Inspiration and/ Kidspiration	• Creating & presenting flow charts • Outlining cause and effect relationships
	Digital Video cameras	• Recording experiments, data gathering • Creating a demonstration of an experiment or procedure
	Animation Software	Creating a demonstration of an experiment or procedure
	Databases	Creating a database that classifies & organizes data
	Word processors	Creating instruction manuals that outline how to follow a procedure
	Timeline making (e.g. Tom Snyder's Timeliner)	Creating timelines
	Internet	• Analysing statistics (e.g. Australian Bureau of Statistics) • Using the Census at School program to analyse statistics and make conclusions http://www.oesr.qld.gov.au/censusatschool/results/results_fs.htm
	RSS Aggregator (free RSS aggregator at http://www.bloglines.com)	Classifying latest developments in a topic or issue that is current in the media
Visual/Spatial	Draw programs (CorelDraw, Adobe Illustrator, Macromedia Freehand)	• Creating computer graphics for website or other multimedia presentation • Creating illustrations to be used in a multimedia presentation • Creating a book cover
	Photo editing software (e.g. Adobe Photoshop, Microsoft Photo Editor)	• Manipulating photo images (e.g. from news stories) to create alternative meaning • Creating book covers
	Image composing programs (Macromedia	Creating computer graphics for website or other multimedia presentation

	Fireworks)	
	Paint programs (e.g. Microsoft Paint, Kid Pix)	• Creating posters that illustrate an idea and/or issue or that advertise an upcoming school event • Creating picture dictionaries
	Web development tools (e.g. Microsoft FrontPage, Macromedia Dreamweaver, Adobe Go Live)	Designing a class/school website
	Excel	Create charts, maps or diagrams
	Animation software (e.g. Macromedia Flash)	Producing an animated production for a community service announcement
	Computer Aided Drawing software	Creating architectural drawings and models to represent concepts and ideas
	Timeline making (e.g. Tom Snyder's Timeliner)	Creating timelines
	Presentation Tools (e.g. PowerPoint)	Visual layout aspect
	Scanner, Digital Still Camera	Taking a series of photos that portray an event, idea or issue
	Inspiration and/ Kidspiration	Creating flow charts, mind maps
	Simulation software	Using simulation software to explore concepts, designs and ideas
	Google Earth	Analysing the topography from satellite images
	Digital Video Camera	Producing a documentary on a topic and/or issue
	Digital Video editing software (e.g. Windows Movie Maker, Adobe Premiere, Apple imovie & Final Cut Express)	Editing footage for a video presentation Manipulating images to create alternative meanings
Musical/Rhythmic	Music composing software (e.g. Sibelius)	Composing a jingle for an advertisement
	Digital Video cameras and audio recording software	Producing a TV advertisement with a jingle
	Microsoft Photo Story	Add music & sound effects to a photo montage
	iPods and Voice Recorder (e.g. Audacity http://audacity.sourceforge.net/ ot Windows Sound Recorder)	• creating songs for mathematical tables and then recording their song onto an iPod using a voice recorder (e.g. Audacity http://audacity.sourceforge.net/) • Using an iPod and a voice recorder (e.g. Audacity http://audacity.sourceforge.net/) to record interviews for a news report • Using an iPod and a voice recorder (e.g. Audacity http://audacity.sourceforge.net/) to record a conversation in the language being studied • Creating a podcast
	Digital Video editing software (e.g. Windows Movie Maker, Adobe Premiere, Apple imovie & Final Cut Express)	Producing a music video for a popular song
Bodily/Kinesthetic	Digital still and video cameras	Creating a video production of dances, sport and role playing,
	Logo and Robotics	Building robots that follow a pre-determined set of instruction

	Interactive whiteboards	Give demonstrations to class
	Keyboarding, mouse, joystick, and other devices for movement	Using simulation programs
Interpersonal	Presentation Tools (e.g. PowerPoint)	Creating group presentations
	email	Email projects
	Discussion Forums, Chat, Listservs	Discussing ideas and projects being studied
	Word processing	Group editing of collaborative projects (e.g. a class newspaper, class website), Brainstorming ideas as a group
	Inspiration and/or Kidspiration	Group brainstorming, mind mapping, concept maps
	Web Quests	Students find the solution to a problem by collaborating with other group members
Intrapersonal	Word processing	Brainstorming, writing an autobiography, diaries, journals
	Inspiration and/or Kidspiration	Individual brainstorming, mind mapping, concept maps
	Internet	Self paced research
	Multimedia software packages	Multimedia portfolios
	Microsoft Photo Story	Create a photo montage that gives a reflection of an event and/or issue
Naturalist	Digital still and video cameras	Record visuals during field trips
	Windows Sound Recorder	Record audio during field trips
	Word processing	Classifying & journaling environmental information
	Databases	Classifying natural information
	Presentation Tools (e.g. PowerPoint)	Presenting data that shows trends and changes over time
	Inspiration and/ Kidspiration	Creating a diagram to represent a food chain