A Framework for Web 2.0 Learning Design

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This paper describes an approach to conceptualising and performing Web 2.0 enabled learning design. Based on the TPACK model of educational practice, the approach conceptualises Web 2.0 learning design by relating Anderson and Krathwohl's Taxonomy of Learning, Teaching and Assessing, and different types of constructive and negotiated pedagogies to a range of contemporary Web 2.0 based learning technologies. The learning design process can then be based upon the extent to which different Web 2.0 technologies support the content, pedagogical, modality and synchronicity requirements of the learning tasks. The model is resilient to the emergence of new Web 2.0 tools in so far as it views technology as only a mediator of pedagogy and content with attributes to fulfil the needs of the learning episode. A range of possible use cases, categorisations and examples are offered to illustrate the learning design concepts and processes, in order to promote more savvy and expedient application of Web 2.0 technologies in learning and teaching contexts.

Keywords: Web 2.0, learning design, pedagogy, tasks, technology.

Learning Design and Web 2.0

There has been an explosion in the number of Web 2.0 tools available for educators to use with their students. The open, collaborative and contribution-based nature of the Web 2.0 paradigm and its associated tools holds great promise for the future of education – it appears that there is finally accord between the design of technology and the student-centred, interactive approaches being advocated by contemporary educational theory. The online nature of these tools and the new paradigms they facilitate enhances the possibilities available for distance education. So powerful are the potentials of Web 2.0 tools that they are often being used in face-to-face classes (Redecker, Ala-Mutka, Bacigalupo, Ferrari, & Punie, 2009). However with such a variety of tools continually emerging it can be difficult for teachers to keep pace with the technologies at their disposal, let alone conceptualise them into a schema for application.

It is somewhat difficult to reach consensus over what is meant by 'Web 2.0' because rather than having a hard boundary, the term 'Web 2.0' has more of a gravitational core (O'Reilly, 2005). Alexander (2006) points out that ultimately the label is far less important than the concepts, projects and practices it incorporates which include:

- **social software** – where multiple users can collaborate with one another and contribute to the authorship of content
- **micro-content** – blog posts, text-chats, video clips, rather than monolithic compositions
- **open** – these tools and the often massive amounts of user generated content that they create and organise are characterised by being freely available on the web
- **sophisticated interfaces** – Using AJAX, XML, RSS, CSS to create drag and drop, semantic, extensible and aesthetically pleasing website designs that can provide notification of changes.

Among the number of Web 2.0 tools, the educational field is still searching for frameworks for thinking about how to design learning experiences using Web 2.0 technologies. 'Learning design' can be used to describe the "learners and a space where they act with tools and devices to collect and interpret information through a process of interaction with others" (Oliver, Harper, Wills, Agostinho, & Hedberg, 2007, p. 65). However a recent (July, 2010) search of the Educational Resource Information Center (US Department of Education) using the terms 'Web 2.0' and 'learning design' returned only three results. Bensona & Samarawickrema (2009) describe how different types of blended learning contexts can be supported by different levels of dialog, autonomy and structure, but make only passing reference to the sorts of online technologies that support these different types of contexts. Conole & Culver (2009) report on a Cloudworks tool that supports

the sharing of learning designs between teachers, but does not provide recommendations about learning design using Web 2.0 tools. Greener (2009) discussed issues relating to learning design and Web 2.0 tools such as blogs and wikis, but did not present a framework to support design. This indicates a scarcity of work specifically relating to Web 2.0 enabled learning design.

It should be noted that there has been a great deal of commentary about Web 2.0 and many examples of its use (for instance, see Alexander, 2006; Downes, 2005; or the *Computers in the Schools* special issue on Web 2.0 in Education, Issues 3 & 4, 2010). Based on over 280 cases, Redecker et al. (2009) provide an excellent report on the impact of Web 2.0 innovations on education and training in Europe. Their review provides examples of ways in which Web 2.0 tools can be used to enable new models of collaboration, personalise learning pathways, promote diversity and take advantage of a societal context (Redecker, et al., 2009). However there is very little work that examines how educators might make sense of the wide range of Web 2.0 tools available in the context of learning design, so that they can appropriately select and apply Web 2.0 tools that match the learning requirements of their curriculum.

In so far as defining the sorts of knowledge and skills that teachers require in order to successfully implement technology based learning designs, Mishra and Koehler (2006) present a Technological Pedagogical and Content Knowledge (TPACK) model (see Figure 1).

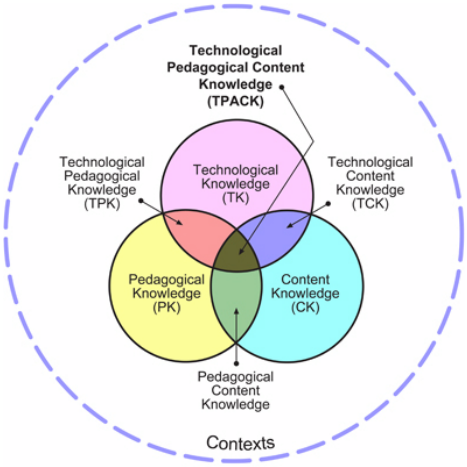

Figure 1 – The TPACK model of educational practice

The TPACK approach emphasises the importance of the intersections between Technological Knowledge, Pedagogical Knowledge and Content Knowledge, and proposes that effective integration of technology into the curriculum requires a sensitive understanding of the dynamic relationship between all three components. In so far as it addresses the content, pedagogy and technology elements of educational practice the TPACK model can be used as a foundation for analysing learning design employing Web 2.0 tools. In particular and for the purposes of this paper:

- the content is the discipline specific knowledge that the learning design will address
- the pedagogies are the types of interactive approaches that the learning design attempts to engage, based on the their intended level of narrative and construction they entail, and
- the technologies are Web 2.0 tools with their social emphasis, micro-content orientation, open access and sophisticated interfaces.

This paper provides an integrated framework for conceptualising and performing Web 2.0 learning design based upon Anderson and Krathwohl's (2001) Taxonomy of Learning, Teaching and Assessing as well as different types of negotiated and productive pedagogies. Based on this conceptualisation, a range of considerations are identified to support the matching of Web 2.0 tools to learning requirements. Two

examples are provided to illustrate how the requirements of the task and the conceptualisations presented can be used to select and create Web 2.0 learning designs in order to meet learning and teaching needs.

Online Content and their Tasks

Critical to the use of technology in education is the realisation that the technology is simply the mediator for collaboration and representation, and that it is the type of task and thinking processes in which students engage that determines the quality of learning. Thus it is useful for educators to start with the types of thinking and processes with which students are required to engage before identifying technologies that will best facilitate them. Anderson and Krathwohls' (2001) Taxonomy of Learning, Teaching and Assessing provides a framework for conceptualising learning that incorporates a Knowledge dimension and Cognitive Process dimension. Using Anderson and Krathwohls' (2001) Taxonomy not only enables a more context-free model to be formed but also the model to retail a focus on the learning rather than the technology.

The Knowledge dimension of Anderson and Krathwohl's (2001) taxonomy relate to the sorts of subject matter content being addressed and incorporates the following categories:

1. Factual knowledge – discrete pieces of elementary information, required if people are to be acquainted with a discipline and solve problems within it
2. Conceptual knowledge – interrelated representations of more complex knowledge forms, including schemas, categorization hierarchies, and explanations
3. Procedural knowledge – the skills to perform processes, to execute algorithms and to know the criteria for their appropriate application
4. Metacognitive knowledge – knowledge and awareness of one's own cognition as well as that of other people.

(Anderson & Krathwohl, 2001, pp. 27-29)

The levels of the Cognitive Process dimension of Anderson and Krathwohl's (2001) model include Remembering, Understanding, Applying, Analysing, Evaluating and Creating, which represents a refinement of Bloom's (1956) Taxonomy. These represent a continuum from lower order thinking skills to higher order thinking skills, with lower level thinking capacities being a necessary prerequisite for corresponding higher order thinking skills to occur. Anderson and Krathwohl's (2001) model outlines a number of sub-processes that comprise each level, and Churches (2008) has extended these to incorporate the sorts of cognitive processes that specifically relate to digital learning (Churches' additional digital processes listed in italics):

- **Remembering** – Recognising, listing, describing, identifying, retrieving, naming, locating, finding, *bullet pointing*, *highlighting*, *bookmarking*, *social networking*, *social bookmarking*, *favouriting/local bookmarking*, *searching*, *googling*
- **Understanding** – Interpreting, Summarising, inferring, paraphrasing, classifying, comparing, explaining, exemplifying, *advanced searching*, *blog journaling*, *twittering*, *categorising*, *commenting*, *annotating*, *subscribing*
- **Applying** – Implementing, carrying out, using, executing, *running*, *loading*, *playing*, *operating*, *hacking*, *uploading*, *sharing*, *editing*
- **Analysing** – Comparing, organising, deconstructing, Attributing, outlining, finding, structuring, integrating, *mashing*, *linking*, *tagging*, *validating*, *reverse-engineering*, *cracking*
- **Evaluating** – Checking, hypothesising, critiquing, experimenting, judging, testing, detecting, monitoring, *blog/vlog commenting*, *reviewing*, *posting*, *moderating*, *collaborating*, *networking*, *refactoring*, *alpha/beta testing*
- **Creating** – designing, constructing, planning, producing, inventing, devising, making, *programming*, *filming*, *animating*, *blogging*, *video blogging*, *mixing*, *remixing*, *wiki-ing*, *publishing*, *videocasting*, *podcasting*, *directing/producing*

Note that each of these processes (or 'verbs') are generalisations, and the extent to which they actually engage the level of thinking of the Cognitive Process category depends on the task itself and the students' level of cognitive engagement with it. As well, while Churches (2008) work does relate thinking processes to digital

technologies, it does not provide a means of relate these processes to the types of pedagogies that learning designs may apply to achieve the intended discipline learning outcomes.

Online Pedagogies

There are many different aspects of pedagogy that can play a determining role in the success of a learning episode, including an understanding of how to cater to the target audience, how to specify tasks clearly and how to develop a positive learning environment (Mishra & Koehler, 2006). However many of these sorts of pedagogical considerations relate more to the specific context within which learning is occurring, so in terms of developing a generally applicable framework the degree of negotiation and production that learning designs apply will be used, as follows:

- **Transmissive** – transmission-based information delivery approaches, where a stream of information is broadcast to learners
- **Dialogic** – centred on discourse between participants, and often involving exemplars followed by periods of activity and feedback
- **Constructionist** – where learning occurs by developing a product
- **Co-constructive** – groups of learners complete a series of goal-related tasks to produce an artefact.

There are merits to each learning activity design, depending on the stage of the learning cycle. For instance, direct instruction approaches are considered by some to be more appropriate when students are yet to form understandings about a particular topic (Magliaro, Lockee, & Burton, 2005). One espoused instructional approach is for developing student capacity in a domain is expert modelling, whereby a teacher demonstrates a to-be-learned process which thereby offering students a 'cognitive apprenticeship' (Collins, Brown, & Holum, 1991). This allows teachers to not only directly impart subject matter knowledge but also attitudes, thought processes, problem solving techniques and a whole range of other underlying. However transmissive approaches generally do not take maximum advantage of the benefits derived from more socio-constructivist learning designs, including the active engagement of students, support from peers and the ability to socially construct meaning (Hedberg, 2003; Jonassen, 2000; Land & Hannafin, 2000).

Dialogic pedagogies allow students to extend beyond what they could have achieved in isolation to learn in their Zone of Proximal Development (Vygotsky, 1978). Laurillard (2002) presents a comprehensive Conversational Framework for dialogic learning using technology. According to this model learners form complete understanding by apprehending the structure of discourses, interpret forms of representation, act on descriptions of the world, apply feedback and reflect upon the goal-action-feedback cycle. Critically, the model highlights the importance of discursive (conversational) flows to enable these processes to occur. Empirical evidence shows that conversational approaches can improve student learning; Waite et al. (2003) describe how transforming the classroom into a more conversational environment (both between students and with the teacher) led to a doubling of the percentage of A grades that students received in a distributed systems course.

Constructionist pedagogy was first described by Seymour Papert (1986) whereby students learn by reconstruction rather than as a transmission of knowledge, and assumes that learning is most effective when students are constructing a meaningful product. Inspired by constructivist learning theory, constructionism is argued to improve learning by virtue of engaging participants in personally meaningful productive pursuits over which they exercise a large degree of control (Willett, 2007). Clements (2009) describes virtual constructionism as "understanding the relationship between teaching and student learning, and integrating it effectively with e-learning technologies to support students in constructing meaningful experiences". Thus to apply virtual constructionist approaches requires an understanding of which tools afford production and creation.

Co-constructive pedagogies place responsibility for production on groups of learners so that they can benefit from both the peer-assisted elements of dialogic pedagogies as well as the productive component of

constructionist pedagogies. While there can be process losses incurred by attempting to coordinate such activity online (Neale, Carroll, & Rosson, 2004) the intention is that with savvy learning design the benefits of social interaction (Mayer, 2005) and more active participation (Willett, 2007) outweigh any extra collaborative overhead experienced by collaborating online. These pedagogies can be distinguished by their degree of negotiation and production, as shown in Table 1.

Table 1 – Pedagogies categorised according to their degree of negotiation and production

	Non-Negotiated	**Negotiated**
No product	Transmissive	Dialogic
Product	Constructionist	Co-constructionist

Note that the definitions above do not define the particular role of the teacher or students; it is possible that students could be applying more instructional approaches by creating presentational materials for their peers, or that the teacher could be part of a co-constructive pedagogy. In terms of technology selection for the online pedagogy the important element is the way in which all participants interact.

One final dimension that determines the nature of pedagogy applied is the temporal organisation of activity, either synchronous or asynchronous. Synchronous activities enable instant access to feedback and troubleshooting support. Asynchronous activities allow anywhere anytime access and provide students more time for reflective thinking. The type of interaction required will influence the technology that is selected for the task. The next section discusses the types of Web 2.0 technologies available to educators, with respect to the types of online content they can represent and the type of activity they facilitate.

Web 2.0 Technologies

There is a vast range of Web 2.0 technologies at the educators' disposal. The ever-expanding number and type of technologies makes it practically impossible to describe the field. However the list below, while not claiming to be exhaustive, attempts to provide a summary of the types of Web 2.0 technologies currently available and the potential they afford for representing content and facilitating collaboration. Distinguishing characteristics of these tools are the modalities of representation (text, image, audio, video) that they incorporate and the degree of synchronicity they enable.

Social bookmarking

Social bookmarking sites such as Delicious (http://delicious.com) and Simpy (http://www.simpy.com) allow communities of practice to save and exchange their favourite websites. Systems such as iCite (http://www.icyte.com) enable users to archive previous versions of pages irrespective of whether they have changed. Not only does social bookmarking allow people to store their bookmarked sites online for anytime anywhere access but systems such as Diigo (http://www.diigo.com) allow for the creation of groups so that people can build a collective information repository. The approach also allows users to find people of common interests and form collaborative networks. Essentially these tools promote the recall, identification and exchange of factual information, although their community-building features can sometimes be used to facilitate discourse. Sharing of links and information is predominately text-based.

Wikis

Collaborative authoring has been one of the most popular uses of Web 2.0 technologies as is evidenced by the hugely successful Wikipedia. Based on the Mediawiki technology, the site has over 75000 active contributors who have created more then 13 million articles in over than 260 languages and attracts over 65 million visitors a month (http://en.wikipedia.org/wiki/Wikipedia:About). However there are hundreds of wiki tools available for use (for instance, http://www.wikimatrix.org allows visitors to compare the features of over 120 wikis). Many of these are served and freely available for use, such as PBworks (previously PBwiki, http://pbworks.com/academic.wiki), Wetpaint (http://www.wetpaint.com) and Wikispaces

(http://www.wikispaces.com). Contributions were traditionally limited to text and image, though embedding of audio and video is now more common. These wikis allow educators to not only organise and interrelate conceptual information for their students, but more importantly allow students to co-construct knowledge.

Shared Document Creation

At the document level tools such as Google Docs (http://docs.google.com) and Buzzword (http://buzzword.acrobat.com) allow users in different locations to access the same file and edit and comment it in much the same way as for a Microsoft Word document. For more smaller and simpler applications Writeboard (http://www.writeboard.com) allows users to collaboratively author through a text field but still provides a comprehensive change tracking system. Google Wave (http://wave.google.com) allows participants to synchronously hold text-chat conversations while they edit documents containing richly formatted text, photos, videos and so on. The synchronous document, text and audio sharing capabilities of web-conferencing systems such as Dim Dim (http://www.dimdim.com) and WizIQ (http://www.wiziq.com) also facilitate effective collaborative authoring of documents. All of these shared document creation tools have obvious application for the collaborative authorship of teacher documents and student projects, but also offer a logical means for teachers to provide students with formative feedback and support on their assignments (i.e. supports negotiation).

Blogs

The ease with which blogs allow individuals or consortiums to post, sequence and organise information on the web has led to their rapid application in a variety of contexts. Educationally speaking, blogging tools such Blogger (http://www.blogger.com), Edublogs (http://edublogs.org) and Wordpress (http://wordpress.com) enable students and teachers to publish their experiences and reflections, providing insight into their thoughts and practices. The capacity for filtered comments to be placed on blogs facilitates negotiated learning approaches. Text and image representation are standard blogging modalities. Blogging tools such as Glogster (http://www.glogster.com) and Scrapblog (http://www.scrapblog.com) provide an interface that allows students to be more creative in the way they use multimedia to express their ideas, thus supporting a wider range of content representation. Because blogs sequence posts chronologically in much the same way as a diary they are often used for reflecting thinking, which in turn makes them suitable for metacognitive tasks. Some of the most successful uses of blogs for teaching and learning relate to the creation of classroom blogs so that students collaboratively form and reify their understandings. Pertinent examples of this include Podkids Australia (http://www.podkids.com.au), Kingsford Smith School blog (http://kssvideo.wordpress.com) and Wormbins (http://wormbins.edublogs.org).

Microblogging

A recent use of Web 2.0 to collaborate is the use of text-based microblogging tools such as Twitter (http://www.twitter.com), Jaiku (http://www.jaiku.com) or Identica (http://identi.ca) to enable real-time communication and tracking of events. Not only useful for Hollywood celebrities and politicians to instantaneously and immediately reach out to the public without fear of being spammed (you choose who you follow, not who follows you), microblogging tools afford real potentials for teaching and learning. At the EDMEDIA2009 conference Twitter was used for all conference participants to collaborate about the keynotes and sessions they were attending, enabling an informative and often provocative subtext to occur. Similarly microblogging tools can be used in class to coordinate activity, document an event, or follow a live-feed for an event in progress (be it locally or on the other side of the world). These tools obviously support dialogic approaches, however the 140 character limit placed on contributions means that the knowledge exchanged is largely factual in nature. The recent emergence of more multimedia-oriented microblogging tools such as Coveritlive (http://www.coveritlive.com/) and Plurk (http://www.plurk.com) expands the amount and type of knowledge that can be shared through these dialogic processes.

Presentation Tools

There has been criticism of the way traditional presentation tools such as Microsoft Powerpoint and Apple's Keynote have been used to help audiences form understanding (McKenzie, 2000). Yet these tools have been the mainstay of presentation practices for most educators because until recently there was a paucity of viable alternatives. But now tools such as CoolIris (http://www.cooliris.com) and Prezi (http://prezi.com) allow for the nonlinear organisation of information that can be naturally navigated in multiple directions and at a variety of scales. This means that students as well as teachers can start to restructure information in ways that more accurately represents the relationships between the component concepts. At the same time, tools such as Slideshare (http://www.slideshare.net), Authorstream (http://www.authorstream.com) and Vcasmo (http://www.vcasmo.com), enable the online distribution of multimedia presentations, breaking down the temporal and institutional barriers that have traditionally constrained the dissemination of such resources.

Image creation and editing

Images afford the persistent illustration of the relationship between several elements of information, making them suitable for representing conceptual knowledge. There are a range of online image repositories and tools that allow users to move beyond Microsoft's Paint and Clipart when they are creating and working with visual representations. Pixlr (http://www.pixlr.com/editor) provides online image creation capabilities that are strikingly similar to many of those in Illustrator but available for free via a web-browser. Similarly Photoshop Express (http://www.photoshop.com) provides browser-based access to a scaled down subset of image editing capabilities found in Adobe Photoshop. Sites such as Flickr (http://www.flickr.com) and Wikimedia commons (http://wikimedia.org) provide a range of images that can be used as starting points for image creations. These tools all support the individual creation of conceptual knowledge. However there are also tools for collaborative image creation and editing. For instance Dweeber (http://wdweeber.com), Scriblink (http://www.scriblink.com) and Scribblar (http://www.scribblar.com) provide free synchronous online whiteboards with text-chat and file-system facilities, with the latter two tools also including image-upload and voice capabilities. Online diagramming tools such as Autodesk (http://draw.labs.autodesk.com/ADDraw/draw.html) and Gliffy (http://www.gliffy.com) allow the online drawing and sharing of diagrams such as flowcharts and architectural designs. Thus contemporary Web 2.0 tools offer a range of options for either individual or collaborative construction of images, depending on the requirements for the learning experience.

Podcasting and the use of audio

The pace with which narrative can be contributed makes audio a natural modality for supporting dialogic approaches to learning. Free audio tools such as Garageband (MacOS) or Audacity (WindowsOS) it is possible for people to create, edit and enhance their audio recordings so that they can be made available as podcasts on their own web pages or podcast distribution sites such as Houndbite (http://www.houndbite.com) and Chirbit (http://www.chirbit.com). However some sites are extending the ways in which audio is used online to more naturally support narrative approaches. For instance Voxopop (http://www.voxopop.com) provides voice-based discussion boards that not only provide enhanced accessibility but also open up a range of new possibilities for audio-centric learning domains such as music and languages. Tools such as Blogamp (http://blogamp.com) allow audio-players to be embedded in blogs so that students can develop and reflect upon learning processes relating to speech and sound. At the same time Voicethread (http://voicethread.com) allows the exchange of spoken contributions surrounding artefacts uploaded by users, creating the possibility for collaborative analysis using a dialogic modality that affords faster contribution and greater personalisation.

Video editing and sharing

Online video sharing sites such as Youtube (http://www.youtube.com), Vimeo (http://www.vimeo.com), Teachertube (http://teachertube.com) and Howcast (http://www.howcast.com) have made the exchange and use of video in the classroom a mainstream event. Because video provides a synchronized stream of audio and visual information it is a particularly effective means of representing procedural information. Search engines such as Google video (http://video.google.com) or Vodpod (http://vodpod.com) allow these and other high

quality videos from a range of reputed institutions (such as those from MITs open courseware, available at http://ocw.mit.edu) to be simultaneously queried using a single meta-search. Recently a range of online video editing tools have also become available, from tools that allow you to convert streamed videos to a variety of file formats for your computer (http://vixy.net), to play on your ipod (http://tooble.tv), and to create an online video with only the parts of a Youtube video you want (http://tubechop.com). While Movie Maker (Windows) and iMovie (Mac) provide free tools for creating and editing video, sites such as Jaycut (http://jaycut.com) provide video editing capabilities directly through a web-browser. Collaborative multimedia editing and video creation can be supported using Shwup (http://www.shwup.com). Ustream (http://www.ustream.tv) allows users to stream video instantly in order to create a live online television channel. The spectrum of tools available for sharing and editing video means that pedagogies can vary from being anywhere between transmissive to co-constructive.

Screen recording

Although screen recording software is not strictly speaking a Web 2.0 technology, when shared online using sites such as Youtube they can create a powerful mechanism for supporting the learning of technological processes. Free screen recording software such as Jing (Mac or Windows, outputs to SWF, available at http://www.jingproject.com), Camstudio (Windows, outputs to AVI or SWF, available at http://camstudio.org) and Wink (Windows, outputs to SWF, available at http://www.debugmode.com/wink) allow users to record and add audio commentary to their desktop actions. Jing also comes with a free online upload space for simple dissemination of recordings (http://www.screencast.com). This means that teachers and students can now capture and share IT processes in a form that better suits the content being represented, as compared to the more traditional approach of combining images with text.

Mindmapping

Drawing mindmaps encourages people to reflect upon the important elements and relationships of a concept or idea, which in turn can help improve the understanding. Freemind (http://freemind.sourceforge.net) and Xmind (http://www.xmind.net) are open source mindmapping tools that students and teachers can download and install on their machine, which allow the creation of dynamic maps incorporating a range of media and files. Recently a range of free browser-based mindmapping sites have emerged which not only enables simpler access but also allows collaborative mindmapping to take place. Bubbl.us (http://bubbl.us) and Mindomo (http://www.mindomo.com) allow easy creation, saving and asynchronous sharing of mindmaps using a permissionable directory structure. Mindmeister (http://www.mindmeister.com) and Mind42 (http://www.mind42.com) allow synchronous editing of mindmaps, including image embedment features. Mind42 also providing an audio collaboration facility using the Google Talk gadget. Because mindmaps are suitable for representing schema, mindmapping tools can be used in a range of metacognitive tasks.

Digital Storytelling

There are a range of Web 2.0 technologies that specifically support the telling of stories, from simply documenting a sequence of events to sharing stories that are deeply personal (Levine, 2010). These support users to move beyond Microsoft Photostory to use online image and audio mixing tools such as Animoto (http://animoto.com). Some interesting alternate genres are provided, for instance, tools such as Pixton (http://pixton.com/uk) and Toondoo (http://www.toondoo.com) allow users to create and share stories in the comic genre using text and a range of archived or user-uploaded images, all directly through a web browser. Kerpoof (http://www.kerpoof.com) and Goanimate (http://goanimate.com) and XtraNormal (http://www.xtranormal.com) to extend these features to enable the creation of animations. While the cartoon format may seem elementary, having students represent events or processes using such tools requires them to distil the relevant key information and summarise it in a new form, thus supporting commitment to memory and abstraction of processes.

Conceptualising Web 2.0 Learning Designs

A range of learning designs that utilise the Web 2.0 technologies discussed above is presented Table 2.

Table 2 – A framework of Web 2.0 learning designs

Knowledge Dimension	Cognitive Process Dimension					
	Remember	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Factual Knowledge	**Microblogging** – document and share new items of factual knowledge with a group as they come to hand (D).	**Social bookmarking** – bookmark with facts relevant to a certain topic (D). **Podcasting** – provide definitions of terms on an audio discussion board (D).	**Image creation** – construct an image that represents or describes an item of knowledge (C).	**Wikis** – analyse the definitions provided by peers and provide them with constructive comments on how to improve (D).	**Social bookmarking** – post comments evaluating the quality of factual information saved to the group social bookmarking site (D). **Blogs** – evaluate the factual quality of information on peer blogs and post constructive feedback (D).	**Image creation** – use a collaborative whiteboarding tool to create new definitions for an area of innovation being considered (CC).
Conceptual Knowledge	**Wikis** – identify the main concepts relevant to the topic on the wiki (C). **Image creation** – draw an image to represent a concept or set of concepts (C). **Podcasting** – listen to a podcast of a lecture and attempt to recall the main concepts (T).	**Blogs** – explain the concepts and issues of a topic as they arise (C). **Presentation tools** – represent and present the knowledge and relationships of a conceptual domain (C). **Wikis** – explain a set of concepts on a wiki (C). **Mindmaps** – draw a mindmap representation of a concept or domain (C).	**Digital storytelling** – create a story that exemplifies/applies a concept (C). **Video** – create a video that applies the concepts you have learnt to a concrete situation (C).	**Wikis** – construct/adjust a knowledge network so that it appropriately interrelates concepts (C). **Podcasts** – collaboratively analyse an image or artefact using Voicethread (D).	**Wiki** – evaluate the quality of peer conceptual explanations and make alterations/suggestions as appropriate (CC). **Blog** – evaluate the conceptual quality of peers based on their blog postings and provide them with constructive feedback (CC).	**Shared document creation** – collaboratively construct a report/campaign that addresses the key issues of a topic of study (CC). **Mindmaps** – demonstrate a new conceptual understanding or innovation using a mindmap (C).
Procedural Knowledge	**Video –** watch a video of a process and recall the key stages (T). **Podcasting** – create a podcast describing a process that has been observed (C).	**Podcasting** – describe to your peers on Voxopop about the best way to perform a process and then provide constructive feedback to one another (D). **Digital storytelling** – observe an online storyboard and be able to explain the reasons for the processes' sequence of stages (T).	**Blogs** – create a portfolio explaining stages of a products development (C). **Desktop recording** – create a desktop recording that demonstrates how to perform an IT process (C). **Video** – create a video that demonstrates the application of a kinaesthetic process (C).	**Video** – analyse the way in which peers/self performs a process by posting comments on the video page (D).	**Blogs** – evaluate the production process that peers have described and post constructive feedback (D). **Desktop recording** – evaluate the efficiency of peer/self IT process (C). **Video** – evaluate performance of a kinaesthetic process and provide constructive feedback (D).	**Image creation** – draw a flowchart to explain a new process (C).
Metacognitive Knowledge	**Mindmaps** – describe own cognition using a mindmap (C).	**Mindmaps** – explain own thinking based on theories of thinking using a mindmap (C).	**Blogs** – explain how own approaches to learning changes as the subject progresses and as a result of reflecting on learning own	**Blogs** – analyse own learning processes throughout a unit of study (C).	**Blogs** – evaluate the degree to which own learning processes improve as a result of self-reflection (C).	**Mindmaps** – suggest more efficient ways of thinking as a mindmap (C).

			processes (C).			

Anderson and Krathwohls' (2001) Taxonomy has been used to organise the different types of knowledge and learning processes that can be addressed using Web 2.0. Abbreviations have been used to indicate whether the nature of the learning design is more transmissive (T), dialogic (D), constructionist (C) or co-constructive (CC). While the brief and general descriptions provided in the table struggle to demonstrate the full potential of each learning design, they do provide catalysts for the development of engaging Web 2.0 based tasks.

Note that the cognitive process and knowledge refers to the subject matter content to be learnt, not to the way in which the technology is used. As well, the categorisations above relate to how the technology will be used by students, not by teachers. For instance, for a Remember-Process task where students are required to watch a video and recall the key stages of the process, it may be necessary for a teacher to first create the video which requires a higher level of cognitive ability. However the descriptions of the technologies that have been provided above allow educators to identify which technologies may be suitable for their task creation needs.

Table 2 comprises proposed tasks rather than an empirical collection, and many other alternatives could have been included. However several noteworthy patterns exist. Firstly, Web 2.0 technologies enable a great range of opportunities for constructionist and co-constructive learning. Secondly, in terms of levels of knowledge, microblogging supports factual knowledge, wikis are suitable for conceptual knowledge, video and desktop recording support the sharing of procedural knowledge, and blogs and mindmaps are fitting tools to represent metacognitive knowledge. Transmissive pedagogies only appear in lower order thinking processes whereas co-constructive pedagogies feature in higher order thinking processes. This aligns with the proposition by Magliaro et al (2005) that transmissive approaches are more suitable for early stages of schema development. This implies that Web 2.0 technologies that facilitate transmissive pedagogies may be more fitting for early stages of the learning cycle whereas more constructive tools may be more appropriate in the latter stages of a learning cycle. While the trends that occur in Table 2 are based on proposed tasks and as such do not constitute evidence of effects, they do identify possible areas of further research and investigation.

A Web 2.0 learning design process

Determining the content and pedagogies for a particular learning design enables appropriate technology selections. The following elements need to be considered when performing the technology selection process:

1. The overarching learning goals and objectives (outcomes)
2. The type of content in terms of the knowledge that needs to be represented (factual, procedural, conceptual, or metacognitive) and the cognitive processes with which students are expected to engage (from lower level remembering, understanding and applying to higher order analysing, evaluating and creating)
3. The type of pedagogy to be applied
    - transmissive – early stages of learning to provide orientation and prerequisite information
    - dialogic – providing students with the opportunity to more tightly define concept boundaries and negotiate meaning
    - constructive – enabling students to demonstrate their understanding in an integrated and contextualised fashion
    - co-constructive – utilising socio-constructivist approaches to enable students learn while creating together
4. The preferred modalities of representation (text, image, audio, and/or video) which will depend in part upon the type of knowledge being represented and the type of collaboration that will be associated with it, and,

The level of synchronicity required, which will depend on the educational context and the degree of reflective thought desired.

Based on these requirements and on an understanding of the potentials of different Web 2.0 tools to satisfy these requirements, a suitable technology can be selected and learning design applied appropriate to the

discipline and its pedagogy. This necessitates knowledge of the types of Web 2.0 tools that exist and how their affordances relate to each of these requirements. A summary of a variety of Web 2.0 technologies (examples in brackets) is presented in Table 3.

Table 3 – A range of Web 2.0 tools categorised according to how they typically support different knowledge types, pedagogies, modalities, and synchronicities

	Knowledge type	**Pedagogy supported**	**Modalities**	**Synchronicity**
Social bookmarking (Diigo)	Factual	Co-constructive	Text	Asynchronous
Image creation (Pixlr)	Conceptual	Constructive	Image	Asynchronous
Podcasting (Houndbite)	Factual Procedural	Constructive	Audio	Asynchronous
Video sharing (HowCast)	Procedural	Constructive	Video	Asynchronous
Audio discussion boards (Voxopop)	Factual Procedural	Dialogic	Audio	Asynchronous
Image discussion boards (Voicethread)	Conceptual	Dialogic	Audio Image	Asynchronous
Desktop recording (Jing)	Procedural	Constructive	Video (comp. screen)	Asynchronous
Video editing (Jaycut)	Procedural	Constructive	Video	Asynchronous
Video collaboration (Shwup)	Procedural	Co-constructive	Video	Asynchronous
Animation tools (Goanimate)	Procedural	Constructive	Video	Asynchronous
Presentation (Prezi)	Factual Conceptual	Constructive	Text Image	Asynchronous
Wikis (PB wiki)	Factual Conceptual	Co-constructive	Text Image	Asynchronous
Blogs (Wordpress)	All	Constructive / Dialogic	Text Image	Asynchronous
Document creation (Google Docs)	Factual Conceptual	Co-constructive	Text Image	Asynchronous
Synchronous doc creation (Google Wave)	Factual Conceptual	Co-constructive	Text Image	Synchronous
Microblogging (Twitter)	Factual	Dialogic	Text	Synchronous
Multimedia microblogging (Coveritlive)	Factual Procedural	Dialogic/ Co-constructive	Text Image Video	Synchronous
Interactive whiteboards (Scribblar)	Conceptual	Co-constructive	Text Image (Audio collab)	Synchronous
Mindmapping (Mind42)	Conceptual Metacognitive	Co-constructive	Text Image (Audio collab)	Synchronous
Web conferencing (DimDim)	Factual Procedural Conceptual	Co-constructive	Text Image Video	Synchronous

			(Audio collab)	

Table 3 shows how these Web 2.0 tools can be used to satisfy different types of knowledge, pedagogical, and modality requirements. The classification is not meant to be exhaustive nor prescriptive, but it aids the technology selection process by illustrating how the learning design elements may be used to infer Web 2.0 tools. It demonstrates that once the properties of Web 2.0 tools are understood they can be selected to support the type of knowledge, pedagogy, modalities and synchronicity that is required.

It should be emphasised that the categorisations represented in Table 3 are not intended to indicate the only learning designs that the different Web 2.0 tools can satisfy, as many tools can be used for many different purposes. For instance video tools can be used to represent more than procedural knowledge; however if procedural knowledge needs to be represented then video is an appropriate choice. Social bookmarking can be used in an individually constructive rather than co-constructive way, however if a co-constructive approach is required then the characteristics of these tools make them suitable. Blogs can often embed video from external sites, however if the task only requires text and image then blogs may immediately satisfy the requirements of the task. By providing a mapping of requirements to typical Web 2.0 tools Table 3 demonstrates how properties of tools can inform the technology selection and design process.

Note that the types of pedagogies for different levels of knowledge and cognitive processes have not been defined to avoid being overly prescriptive – the particular pedagogies applied will take different forms depending on the discipline. The cognitive process does not feature in Table 3 as this is less associated with particular technologies and more related to the types of learning tasks that are designed.

Examples

These exemplars are derived from a second year education program at XXXX University. As a part of their studies, students are introduced to the above Web 2.0 technologies. Tasks were designed by the teacher of the subject so that students demonstrated their learning using the technologies. The following tables represent a summary of the requirements of each learning design, and the screenshots provide an illustration of the sorts of Web 2.0 learning design solutions that were derived.

Example 1

One of the learning outcomes of the course required pre-service teachers to demonstrate their ability to provide clear instructions for their students about how to operate, manage and administer a blog.

Table 4 – Elements of the blog management task

Learning outcome	Pre-service teachers apply their technology skills to construct clear instructions about how to manage and administer a blog.
Type of content (knowledge and cognitive processes)	This learning outcome primarily relates to demonstrating technology *process* knowledge. The outcome addresses the *application* cognitive process.
Type of pedagogy	In order to assess the ability of students to *apply process* knowledge it is appropriate to have students individually perform a *constructive* technology related procedure to evidence their understanding.
Modalities of representation	To capture the procedural nature of the task a *video* modality is suitable.
Synchronicity	As students are working independently, *asynchronous* capture is sufficient.

Web 2.0 technology: Desktop recording — From Table 3 it can be seen that to support an *asynchronous constructive* computing-related task that applies *procedural* knowledge and is captured using video, desktop recording software (Jing) provides a suitable means of mediation.

Resulting Web 2.0 Learning Design — Students were asked to demonstrate and explain how to effectively organise and manage blog posts in their E-portfolio. The technology enabled students to asynchronously construct a recording that demonstrate their procedural knowledge. The video modality enabled them to represent their process more naturally and clearly than using text and/or images. Learning this technique provided them with the capabilities to provide IT instructions to their prospective students.

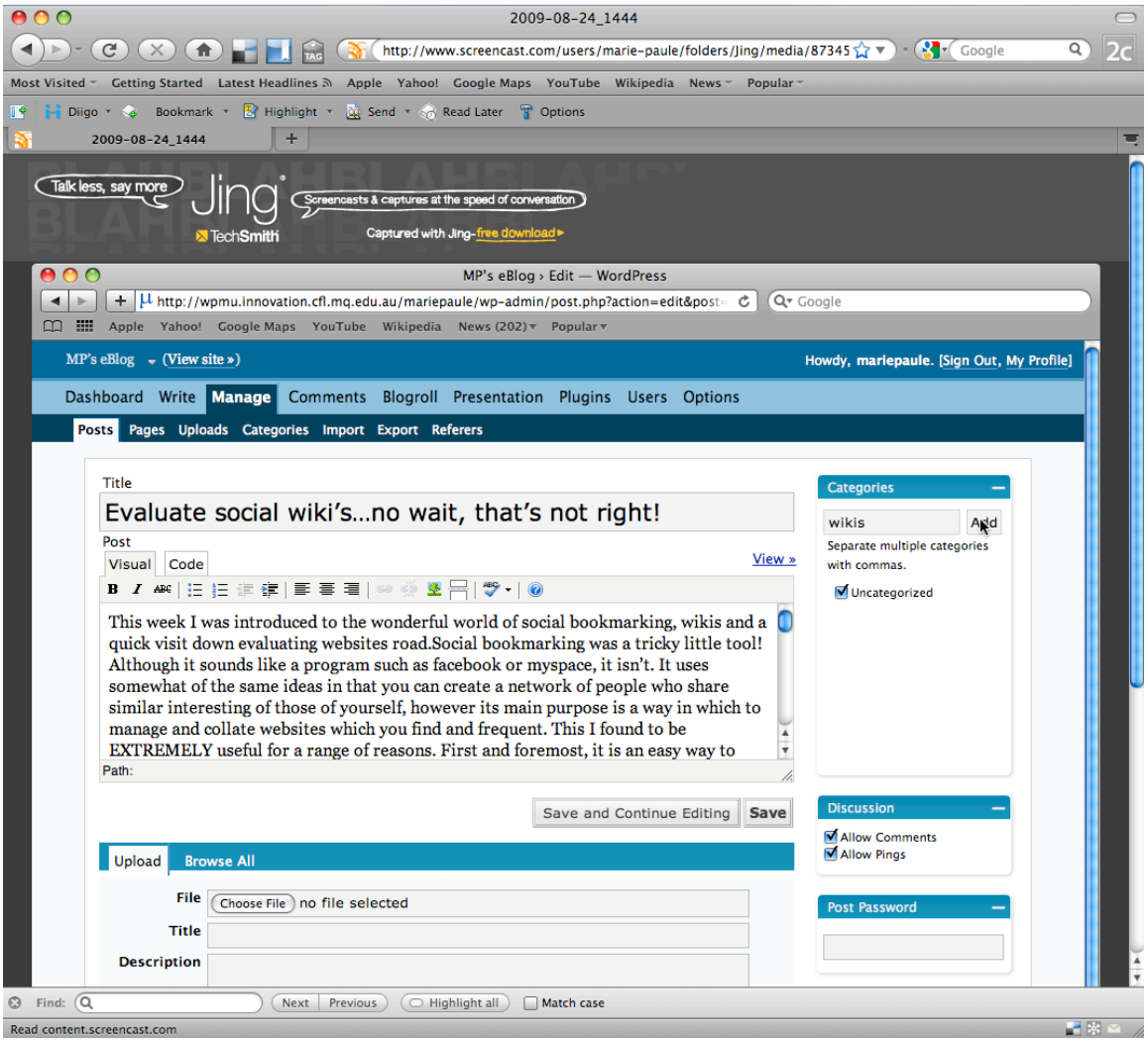

Figure 2 – Student desktop recording demonstrating their ability to apply process knowledge

Example 2

Another learning outcome required pre-service teachers to demonstrate an understanding of the sorts of contemporary technologies available, analyse their potentials, and discuss issues associated with their use.

Table 5 – Elements of the technology analysis task

Learning outcome	Students can identify and interrelate a range of contemporary technologies and evaluate issues associated with their use in the classroom.

Type of content (knowledge and cognitive processes)	This outcome relates to demonstrating *factual* and *conceptual* knowledge. The learning outcome addresses the *identification*, *analysis* and *evaluation* cognitive processes. Thus the task should require students to describe, classify, deconstruct, interrelate and critically evaluate technologies.
Type of pedagogy	In order to benefit from the analysis and reflections of others and due to the large scope of the task, a *co-constructive* pedagogy is useful.
Modalities of representation	The factual and conceptual nature of the knowledge means that *text* and *images* provide suitable modalities of representation.
Synchronicity	As students may complete this task from different places and at different times, *asynchronous* interaction is appropriate.

Web 2.0 Technology: Wiki — From Table 3 it can be seen that to support an *asynchronous co-constructive* task that requires students to identify, analyse and evaluate *factual* and *conceptual* knowledge, a wiki provides a suitable means of mediation.

Resulting Learning Design — At some stage in the first three weeks the pre-service teachers were required to select a contemporary learning technology (either software application or website) and provide a summary of it on the wiki. At the beginning of week four ensure the page is appropriately situated and linked to other pages on the wiki.

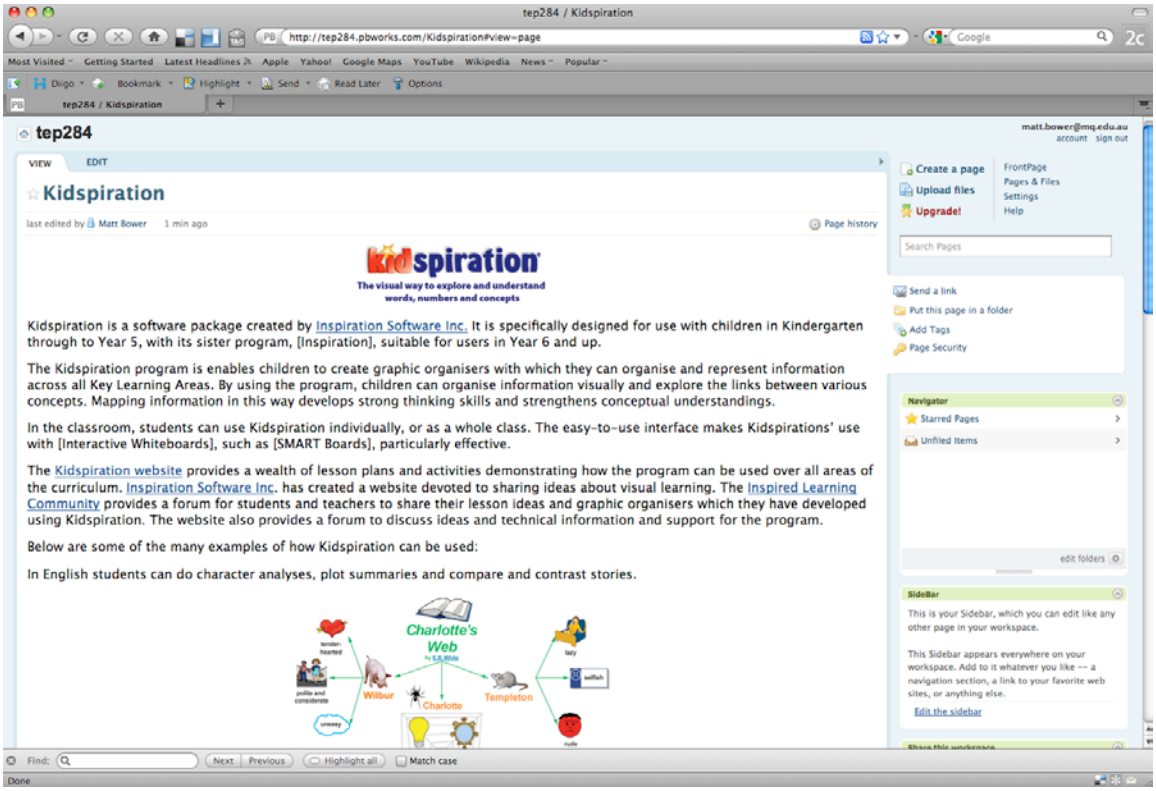

Figure 3 – Student wiki page demonstrating their ability to describe, link and evaluate factual and conceptual knowledge

The wiki with its native ability to represent images and text affords asynchronous representation of students' factual and conceptual knowledge. The co-constructive nature of the task allows students to extend their knowledge base by learning from one another. Requiring students to situate and link their page to others within the wiki encourages them to classify and interrelate their knowledge.

Reflections

With the rapid advancement of technology it is challenging for educators to ensure that learning design approaches remain current. However, while the tools are changing at an ever-increasing rate, the content and pedagogies are in most cases relatively constant. In order to not be overwhelmed by the continually changing educational technology landscape, it is important to retain a focus on technology as a mediator of interaction and a means of representing content. In this way educators can concentrate on pedagogy and disciplinarity, which are the central features of the learning design, without being overly distracted by the technology.

This paper has suggested conceptualisations and processes to support Web 2.0 learning design. Learning designs can be conceptualised in terms of their content (type of knowledge and cognitive process) and the type of pedagogy they apply (either transmissive, dialogic, constructionist or co-constructive). In this paper Anderson & Krathwohl's (2001) taxonomy of learning, teaching and assessing is used to frame different learning design possibilities based on Web 2.0 tools and the types of pedagogies being applied.

Learning design processes require educators to consider the types content and pedagogy being applied, as well as the types of modalities and the degree of synchronicity that is appropriate for the pre-identified learning objectives. Technology selection decisions can then be made based upon the capacity of tools to support these needs. In effect this enables learning designs to be driven by the cognitive and collaborative requirements of learning episodes rather than the ever-changing nature of technology. Table 3 illustrates how particular Web 2.0 technologies may be implied from the pedagogical, content, modality and synchronicity requirements of tasks, and it is these properties that will determine the utility of new Web 2.0 tools as they emerge. It is hoped that the constructs presented in this paper supports educators to more immediately and effectively leverage the potential of Web 2.0 technologies as they reach out to their students in a range of contexts.

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