Conceptualising Web 2.0 enabled learning designs

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This paper describes an approach to conceptualising Web 2.0 enabled learning design based on the TPACK model of educational practice. Anderson and Krathwohl's Taxonomy of Learning, Teaching and Assessing, along with different types of constructive and negotiated pedagogies are related to a range of contemporary Web 2.0 based learning tools. The model is resilient to the emergence of new Web2.0 tools in so far as it views technology as only a mediator of pedagogy and content. A framework of typical use cases is offered to illustrate the range of learning designs that may be applied for different purposes, in order to promote more expedient application of Web2.0 technologies in teaching and learning.

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

Introduction

There has been an explosion in the number of Web2.0 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 and interactive approaches being advocated by contemporary educational leaders. However with such a variety of tools continually emerging it is hard for teachers to keep pace with the technologies at their disposal, let alone conceptualise them into a framework for application.

This paper provides a framework for 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. Suggestions for implementation and further research are also proposed.

Learning design and Web 2.0

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 softwares* – 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.

Due to the recent rapidly explosion in the number of Web 2.0 tools the educational field is still searching for a framework 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 search of the Educational Resource Information Center (US Department of Education) on the 22nd of August 2009 using the terms 'Web 2.0' and 'learning

design' returned only one result, and while this paper by Greener (2009) did discuss issues relating to learning design and Web 2.0, it did not present a framework for design. This indicates a scarcity of work in the area of Web 2.0 enabled learning design.

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 below).

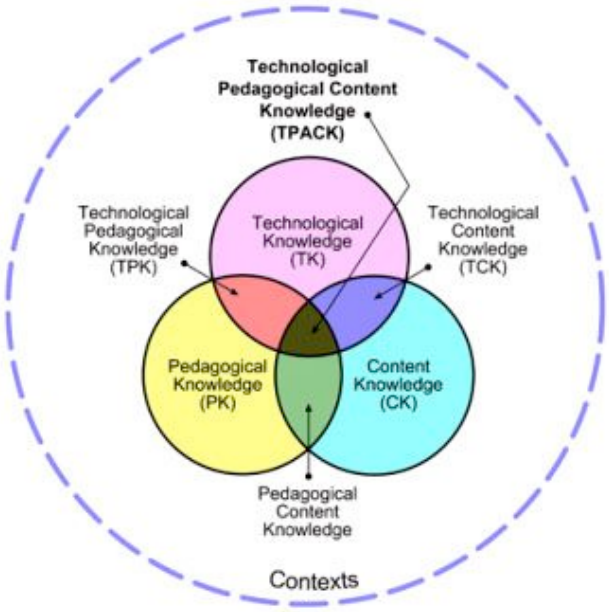

Figure 1: The TPACK model of educational practice

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 Web2.0 based learning design. 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 pedagogies that the learning design attempts to engage, based on the level of narrative and construction they engage, and the degree of synchronicity they entail
- the technologies are Web 2.0 tools with their social emphasis, micro-content orientation, open access and sophisticated interfaces.

The remainder of this paper elaborates on each of these attributes as they relate to Web 2.0 based learning design, and proposes a framework for integrative thinking about them.

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 these.

Anderson and Krathwohls' (2001) Taxonomy of Learning, Teaching and Assessing provides a framework for thinking about learning that incorporates a Knowledge dimension and Cognitive Process dimension. This then can be used to organise and map learning designs in an integrated framework. This not only enables a more context-free model to be formed but also allows the focus to remain 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 (declarative) 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. 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 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 design applies 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, instructional 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 instructional 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 Devlopment (Vygotsky, 1978). Laurillard (2002) presents a comprehensive Conversational Framework for dialogic based learning using technology. According to this model learners form complete understanding by apprehending the structure of discourses, interpret forms of representation, acting 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 professor) led to a doubling of the percentage of A grades that students received in a distributed systems course.

Constructionist pedagogy was first defined 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 in order 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. The important element of the online pedagogy 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 Web2.0 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 Web2.0 technologies currently available and the potentials they afford for representing content and facilitating collaboration.

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. Not only does the approach 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.

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). These wikis allow educators to not only organise and interrelate conceptual information for their students, but more importantly allow students to co-construct such knowledge bases.

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. This has obvious application for the collaborative authorship of teacher documents and student projects, and provides a logical means by which 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. 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 microblogging tools such as Twitter (http://www.twitter.com), Jaiku (http://www.jaiku.com) or Identica (http://identi.ca/) to enable realtime communication and tracking of events. Not only useful for Hollywood megastars 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 recent 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 normally 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) 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. For instance there are free image creation and editing software tools available for download such as Inkscape (http://www.inkscape.org) and GIMP (http://www.gimp.org). However these days the capabilities afforded by such programs are made available without even having to download any software. Pixlr (http://www.pixlr.com/editor) provides online image creation capabilities that are strikingly similar to many of those in Illustrator but all made 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 that are found in the Adobe Photoshop application. 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 such 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 of the learning designer.

Podcasting and the use of audio

The pace with which narrative can be contributed makes audio an natural modality for supporting dialogic approaches to learning. Free audio tools such as Garageband (Mac) or Audacity (Windows) 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). 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. 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 Kidstube (http://www.kidstube.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) allowing 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. Ustream (http://www.ustream.tv) allows users to stream video instantly in order to create a live online television channel. In terms of pedagogical support for the integrating video into the curriculum, there are a range of sites that provide online advice (Flick School, available at http://torres21.typepad.com/flickschool) and exemplars (Curiousworks, available at http://www.curiousworks.com.au). 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. This means that teachers and students can now represent 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, with 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

For an information source regarding digital storytelling it is hard to go past Alex Levine's site http://cogdogroo.wikispaces.com which outlines more than 50 Web 2.0 ways to tell a story. These support users to move beyond Microsoft Photostory to use online image and audio mixing tools such as Animoto (http://animoto.com) and Shwup (http://www.shwup.com). Some interesting alternate genres are provided, for instance, tools such as Pixton (http://pixton.com/uk), Toondoo (http://www.toondoo.com) and Comiqs (http://comiqs.com) allow users to create and share stories in the comic genre all directly through a web browser, and in the case of Kerpoof (http://www.kerpoof.com) and Goanimate (http://goanimate.com), animations can also be created. XtraNormal (http://www.xtranormal.com) allows a 3D audio-visual animation to be created by simply typing in a script. Having students represent events or processes using such tools requires them to distil the key relevant information and summarise it in a new form, thus supporting commitment to memory and abstraction of processes.

A framework for conceptualisation

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

It should also be noted that Table 2 is comprised of proposed tasks rather than an empirical collection, and that 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.

Final comments

Tools for managing courses (such as Moodle, available at http://moodle.org) and creating communities (such as Ning, available at http://www.ning.com) have been omitted from this review, not because they hold no value for educational purposes but because they apply more to the structural level than the activity level of learning. Similarly tools such as LAMS (http://lamsfoundation.org) and Xerte (http://www.nottingham.ac.uk/xerte/) have not been excluded because although they exhibit attributes of Web 2.0 technologies they incorporate such a range of tools that they go beyond the activity level to the topic or course level of learning design, and as such are not easily categorised within the framework.

The rapid growth of Web 2.0 archives such as Gotoweb20 (http://www.go2web20.net) and Cooltoolsforschools (http://cooltoolsforschools.wikispaces.com) provides evidence that the number of Web 2.0 tools available for educational purposes is expanding exponentially. This means that the range possible learning designs that educators can construct is constantly increasing, which can make staying abreast of technology enabled teaching and learning an overwhelming task.

The framework for conceptualising learning design presented in this paper focuses on the nature of the content (type of knowledge and cognitive process) and the type of pedagogy (either transmissive, dialogic, constructionist or co-constructive), with technology selection being based upon the capacity to support these needs. This allows learning designs to be driven by the cognitive and collaborative requirements of learning episodes rather than the ever-changing nature of technology. A table of learning designs using contemporary Web 2.0 technologies has been provided to demonstrate how the technologies may be applied to meet the pedagogical and content requirements of tasks. It is hoped that this supports educators to more immediately and effectively leverage the potentials of Web 2.0 technologies in their classes.

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 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 processes (C).	**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).

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