The wiki way of learning

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This paper presents the argument that the use of wikis in a learning environment involves a different way of thinking, learning and knowing than perhaps many practitioners are familiar with. In particular, wikis foster collaborative, egalitarian learning that is designed to foster group interaction instead of just individual performance. Moreover, wiki based learning involves community ideals and challenging modes of interaction for both learners and instructors. The paper begins by summarising the wiki way of learning. It presents a recent study conducted in a classroom environment into how students conceptualised wiki use and uses a case study of a course in mobile workforce technologies to present the basis for a wiki pedagogy. The paper concludes with a discussion on the both the practical and theoretical implications of using wikis in a tertiary education environment.

Introduction

In this paper, we argue that wikis are tools that challenge traditional ways of approaching learning, and work at an epistemological level, rather than an ontological level. By this we mean that wikis are less about "what is known" (ontology – Scheurich, 1997, p29) and more about "how we know" (epistemology – Scheurich, 1997, p29). Wikis facilitate the construction of knowledge at the screenface (Ruth, 2004) such that interacting with learning processes occurs in place as a construction rather than a body of knowledge to be absorbed.

Wikis are socially oriented, software based web pages that enable free cross platform editing and redistribution of original content (Buffa & Gandon, 2006). Choy and Ng (2007) provide a good overview of the processes available in wikis and their potential uses in educational institutions. While wikis have been around since approximately 1995 (Leuf & Cunningham, 2001), they are part of the so called 'Web 2.0 phenomena' – the read/write web, the natural successor to web 1.0 – the read only web. The read/write web is a hypertextual system for editing and sharing information (Schwall, 2003), more commonly identified as the interactive web. Wikis have been the focus of the scientific community, gaining attention in *Nature*, which highlights the "scientific establishment's cultural resistance" (Tomlin, 2005) to wikis – a kind of disdain for the "new kid on the block". The academic standing of this "interloper" is often questioned, particularly with respect to notions of academic integrity, relevance and accuracy (Giles, 2005). Much debate has occurred over the most well known wiki, *Wikipedia*, with comparisons drawn between it and *Encyclopaedia Britannica* (Giles, 2005), neither winning the argument and both being shown to have merits.

There seems to be much written on the 'how' of using wikis and yet little on the 'why'. The range of social applications of wikis and the kinds of epistemological constraints that are found to occur in such environments are less likely to be the subject of review

and research. Elgort, Smith and Toland (2008) highlight the lack of research that investigates the pedagogical potentials of wikis for collaborative learning. Much research tends to focus on explaining wikis (O'Neill, 2005) and their potential as tools for collaboration, yet most prefer to take the technical road (see Bruns and Humphreys, 2005) and focus on outcomes of their use, that is, the accumulation of knowledge built upon by successive generations of users.

As an example of the focus on outcomes of use, Minocha and Thomas (2007) presented a wiki environment focusing on collaborative development of a requirements analysis document (for software engineering) using a model that required self management of student wiki activities, so as not to increase tutor workload. O'Neill (2005) focused on explaining wikis from a technical standpoint without contesting the underlying assumptions of wiki usage. The social application of wikis and the kinds of epistemological shifts required for their use are a less developed area of research to date. We posit this to be related to the notion of "epistemic authenticity" as postulated by Nystrand (1997), which relates to whether there are "prespecified" answers to questions, the absence of which allows for deep engagement by the student. So wikis allow learners to experiment with 'coming to know' rather than 'reproducing knowledge'.

With the exception of a few people interested in the community aspects of wikis (see Lamb, 2004 for one example), there is little attention to date about how the use of wikis actually comes with a way of thinking, acting and knowing. Moreover, there is an emerging understanding of the community paradigm and intellectual reference models that drive wiki development. How does such thinking integrate into work processes for example (Fuchs-Kittowski and Kohler, 2005), particularly in an academic context? What kinds of 'thinking hats' are required for students to engage with material and with each other in a wiki environment? This paper contends that such processes need to be properly addressed if the technology is to find meaningful use.

There are many successful implementations using the World Wide Web and associated technologies for learning. However, in many of these implementations, there is a tendency to see the online environment as more facilitative of content delivery than participatory engagement (Ruth, 2002). Many users of learning management systems focus on delivery of prepackaged 'knowledge' to be acquired by the student. Some or even many users rarely allow interaction between students and between students and teachers, and rarely employ options that are available for providing interaction 'spaces'. Where they do, it is separate from content. Wikis, on the other hand, shift the focus to construction of knowledge, rather than presentation of information, often giving students an active role in the formation of knowledge representations.

This paper argues that knowledge development with wikis is born out of a frame of co-creation and developmental aspiration, derived from open source and 'free' culture (Lessig, 2004). This epistemology is based on sharing information, collaboration between individuals and co-creation of knowledge. These epistemological frames require a different model to the dominant structure that currently permeates university environments and general business practice. Therefore, the use of a wiki does not just mean using it as a 'tool' to achieve a goal. It requires some characteristics which require careful consideration before a project is undertaken. Some of these characteristics include: collaboration, construction/co-construction of knowledge, different approaches to learning, and different philosophical underpinnings where the authority of the expert is undermined, that is, more oriented towards constructionist

and pragmatic models of inquiry/learning (Metcalfe, 2008). We present the case for these shifts in perspective, then show how a student oriented project (a course in mobile workforce technologies) exemplifies the shift. In particular, the course reinforces the ideals of a wiki epistemology. The paper concludes by discussing the limitations of a wiki approach and put forwards directions for future research.

What are wikis?

O'Neill (2005) states that wikis are a collaborative medium designed to promote content sharing. Wikis allow collaborative editing of pages by participants as well as many other features, depending on the wiki software used (for an overview of different wiki software, see *WikiMatrix* – http://www.wikimatrix.org/). Wikis often allow a history of editing undertaken by members showing an evolving process of page development with a concurrent evolution of participant knowledge and engagement. All wiki page edits are open for debate and critique from any angle by any member of the community. Augar, Raitman and Zhou (2004) highlight that a wiki environment is perfect for what they call computer supported collaborative learning, as they are student centred, giving students shared authority and responsibility for their own knowledge.

Sharing of authority is central to a wiki epistemology, as is empowering participants. Any user can participate in the creation of shared documents, which evolve through shared community goals. The empowerment of users tends to be ignored in wiki research. There are clear definitions of what the technology can do through collaborative endeavours, but little evidence pointing to what values are required to facilitate the successful achievements in one.

Wikis in particular allow more open, potentially fluid interactions between participants in a learning environment. Their main use is to develop pages around a theme, for instance, the *M/Cyclopedia*, educational wikis (e.g. *WikiEducator*) and the most famous example, *Wikipedia* (http://wikipedia.org/). These kinds of wikis are based on a set of similar assumptions – *M/Cyclopedia* (Bruns & Humphreys, 2007) around media, *WikiEducator* (http://wikieducator.org/) around education and *Wikipedia* around encyclopedic knowledge. Each of these include elements such as: discussion and argument (Tumlin, Harris, Buchanan, Schmidt & Johnson, 2007), in depth communication of various levels between participants (Ferris & Wilder, 2006), co-writing and collaboration (Ebersach et al, 2006) and the creation of evolutionary documentation (Wang & Turner, 2004). This demonstrates the range of contexts and spheres in which wikis have been used.

Previous research

Research into 'wikis for learning' is in its infancy, although unlike the parallel early Internet learning research, it seems much more focused on pedagogical requirements (see Wang and Turner, 2006 for example). This is because the very nature of a wiki provides access to the developmental aspects, which are often hidden from the teacher's view. For this reason, the majority of wiki research has focused on the technical aspects of the wiki (Tazzoli et al., 2004), or the development of a special use 'technical' wiki (see Oren et al., 2006), instead of attempting to understand the underpinning epistemology required to build content and community. Lanier's (2005) thought provoking article on "hive" mentality and the thoughtful response from Tumlin et al (2007) shows how these issues are now coming up for debate.

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Wikis assist in displaying student learning as activities become visible both 'in the moment' and in the history of the wiki. The combination of both synchronous and asynchronous features within a single portal is perhaps what draws so many individual teachers to their use. Collectively, teachers and students benefit from a shared collaborative document that could not have been built without unique contributions from different authors. This is not collective thought as a kind of utilitarian idealism as Lanier (2005) suggests, it is a mode of thinking and acting that requires individuality in order to be a collective experience. Such modes of thinking are involved in wiki development and need attention. We argue that the wiki development process is different to traditional development cycles because it is built on different assumptions, which include a wiki epistemology, a focus on community, and participatory involvement.

Context for the study

The *Mobile Workforce Technologies* course focuses on the ways that technology is changing work patterns. It is available as both an undergraduate (advanced/third year) course and as a postgraduate course in second semester each year. While the two courses have different requirements in the length of assessment items and the depth to which they are investigated, the two groups share a single space which exemplifies the notions of communities of practice particularly overlapping communities. While membership of the two main groups (undergraduate and postgraduate) are static, students are able to interact. The two courses, whilst using a single space, have separate lectures and tutorials in which the course subject matter is dealt with at different levels. Students in the postgraduate course typically have more experience in the business field (that is, they are working managers) whilst undergraduate students typically are more familiar with technology (that is, they have been engaged for the preceding years in technology enhanced courses of study). This exemplifies the processes in real world scenarios where different groups within an organisation may have different requirements and different goals. However, students are aware of the individualised outcomes of learning at university and this point of difference is often discussed within the course.

The teaching philosophy of the course focuses on the ways in which technological enhancements facilitate work processes, and how technologies can both enhance and disrupt previously conceived ideas about both work and technology. A less openly stated objective of the course is exploration of how wikis (in this case *TikiWiki* – http://doc.tikiwiki.org/) and other collaborative technologies change both learning and working in collaborative environments.

The initial conception of the course was to develop students as designers of their "own representations of their knowledge", using design as a value adding process to educational interaction (Kimber & Wyatt-Smith, 2006). This philosophy engages students in "ecologies of practice", which "comprise the accumulation of individual and collective experiences … through which people lay claim to being 'professional'" (Stronach et al, 2002, 122). This places learners in the "driving seat" and encourages active knowledge construction. By engaging in a set of practices that make up professional practice, students are able to design further frames of knowledge that re-engage the enactment of professionalism through information and an environment that allows for linking between topics. Wikis also allow for multiple forms of collaboration and interaction which can be tailored to students' preferred style of

interaction, particularly the "vicarious interactor" (Ruth, 2004) who tends to sit on the sidelines, while also providing opportunities to engage in deeper participative practices, thus moving students from the peripheries of practice to more central positions.

The final key conception of the pedagogical framework was that the focus of the course required a textbook that was up to date. Students become disillusioned when their set text contains inaccuracies and out of date information as is the case with evolving mobile technologies. Thus the framework essentially allowed for a 'student written, collaboratively edited textbook'. This allowed students to engage with up to the moment knowledge and acquire greater skills in self directed learning. Figure 1 shows the key aspects of the wiki pedagogy as framed within the course MWT. This figure was developed to explain how the wiki functioned as a learning community.
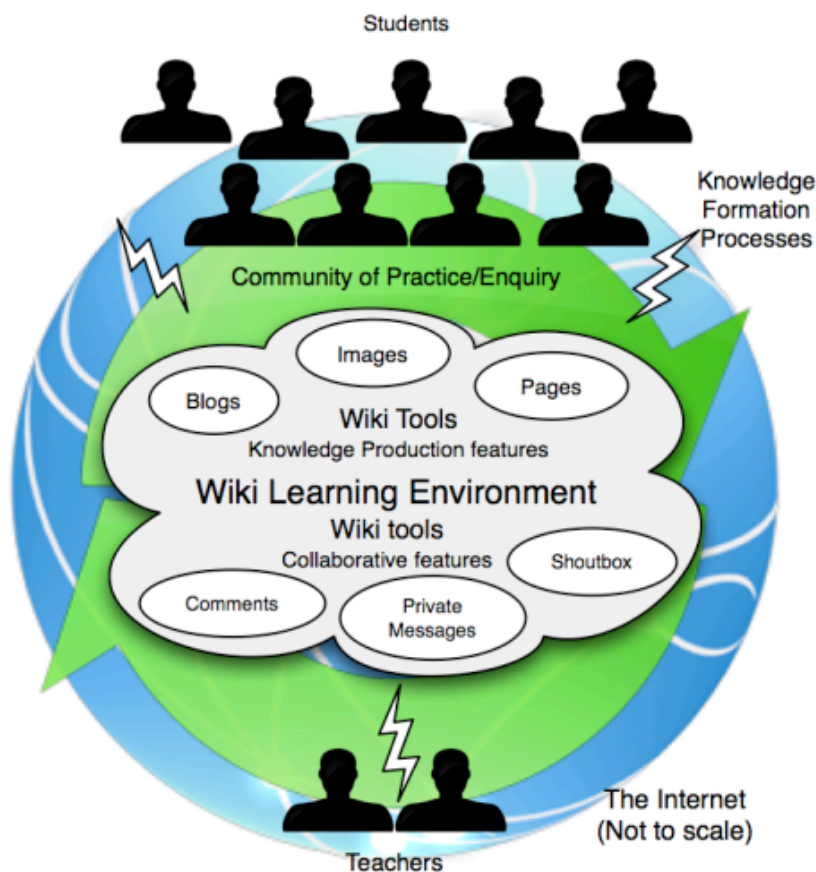

Figure 1: Wiki community of practice pedagogy

Essentially, students commence the course at the periphery and through active engagement with knowledge formation processes are able to move into the community of practice in the wiki learning environment. The range of tools represented in Figure 1 allows students to engage in multiple ways besides text including visually through the incorporation of images and reflective knowledge

development through blogs, and interactively via comments, private messages (messages sent from one student to one or more others that is not visible to those not on the recipient list) and the *Shoutbox* which is an openly visible instant message or chat facility appearing on each page. All of these features allow students to actively reflect on the processes of knowledge development and maintain their activities in a single space.

Participation in the course wiki is mandatory and all assessment is based on work undertaken within the wiki. Much of the student's work is both individual and collaborative, in that students must follow what others are doing, provide cross-links between their work and others' and provide an 'original' contribution distinct from all other contributions. Only one item is not submitted in the wiki (student reflection) although students have the option of using the blog tool to develop their reflections. A description of the use of wikis in this course and others at Griffith University and the course can be found in Ruth and Ruutz (2007).

Methods

The course was first offered as a wiki based course with funding from a 2006 Griffith E-Learning Fellowship. This allowed the set up of the wiki and access to research specific support. As students were introduced to the wiki, they were also introduced to the research process underlying the fellowship. This first offering (2006) is described in Ruth and Ruutz (2007). The second offering (2007) of the course is the subject of this paper and it utilised the same wiki after the semester specific information from 2006 had been removed. There were two cohorts in the current study - 58 postgraduates (PG) and 28 undergraduates (UG) in 2007.

The research followed a mixed methods approach to gain insights not only into what students were doing, but what they thought about what they were doing. Thus there were two main sources of data collection – the wiki content and student reflections. The research project was covered by an ethical clearance granted by Griffith University.

The first data source is the wiki itself and the activities undertaken by the two cohorts. The wiki is openly available that is, not behind a login, although editing requires a login, and it is searchable via *Google*, for example. As a complete environment, the wiki provides many insights into what students are doing. All student work, including pages, blog posts, posts to the shoutbox and other public information was available. The database also contained all activity including private messages between students, although the content of these was not analysed.

The second source of data was student reflections on the course, which allowed students to express their own insights in their own words. These reflections consisted of responses to open ended questions about learning and the use of technology to enhance it. Students were required to reflect on their learning during the semester and these reflections, as well as the content of the wiki, provide more insights into the processes involved than other methods.

Thus there was a range of data available, mostly qualitative and but also some quantitative forms (ie how many students participated). Analyses included content analysis, frequency analysis and self reporting by students in the reflection.

Analysis

The reflections and all wiki entries were read, once as a process for assessment, and at least twice whilst analysing for trends. The first post-assessment reading allowed for many interesting views to be discovered. The second post-assessment reading clarified these views, and allowed for related concepts to be found. This is similar to a process that is facilitated by software such as *NVivo*, however, it also allows for closer attention to the individual texts. Similar examples were grouped in separate documents to allow for exemplars to be extracted.

Data on usage of various wiki features was also collected giving an overview of the level of commitment and engagement exhibited by students. Each feature in the wiki relates to at least one table in the database and these were extracted and summarised.

Findings

Description of activity

Of the numerous features offered by the wiki software, students made consistent use of four, which will be discussed here and are displayed in Table 1. These features were the ability to create new pages, edit pages, post comments, and utilise the shoutbox. These may be broadly categorised as knowledge creation features (creating and editing pages) and interactive features (commenting and 'shouting' out).

Table 1: Feature use by student groups (average in brackets)

Feature	UG	PG	Teaching team	Total
Shoutbox	490 (17.5)	910 (19.0)	59	1449
Comments	266 (9.5)	337 (5.8)	50	654
Create pages	233 (8.3)	379 (6.5)	59	671
Edit pages	1009 (36)	3451 (59.5)	132	4492

During the semester, the 58 PG students and 28 UG students posted 1400 shoutbox messages out of the total 1459. The remaining 59 were sent by the three members of the teaching team. PG students sent 910 'shouts' (average 19.0) while the UG students sent 490 (average 17.5). The other predominately interactive feature used was the comments on each page with a total of 604 comments made, 337 by PG (average 5.8) and 267 by UG (average 9.5).

There were 612 student created pages of which 379 were attributed to PG (average 6.5) and 233 to UG (average 8.3). Pages were updated by students a total of 4460 times with PG responsible for 3451 edits (average 59.5) and UG responsible for 1009 edits (average 36.0).

The shoutbox and comments features are interactive with students able to respond to information already in the wiki, whether a more static page in development or a message in the shoutbox. PG students appear to favour the instant shoutbox feature while UG students appeared to favour the comments feature. Similarly there was a difference in creating pages and editing pages. UG students created more pages on average, while PG students spent more time crafting and improving their entries.

Shifting perceptions

The activities documented above were undertaken during the 15 weeks of semester and provided many opportunities for students to reflect on the process. Students highlighted many issues that provided insights for the teaching team (and which have been and will be implemented in subsequent semesters). As stated above, the key issues for students were shifting from an isolated, closed process of assessment to a more collaborative and open form of assessment, understanding the nature of community and collaboration, and developing a new model of learning. These insights will be discussed now.

Many students appeared to be quite engaged by the prospect of encountering a new learning environment. However this raised new issues for students. During tutorials, some students were working in word processor documents and when asked about it, expressed concern that their work may be 'copied'. This became evident in the reflections, with a number of students mentioning this concern.

One student reflected that some students were wary of working in the wiki due to concerns that 'other students would somehow steal their work' (Male, PG). This holdover from traditional values is one of the challenges of developing collaborative environments. The same student also noted that

> I have avoided relinquishing control: I didn't trust in the potential of my fellow wiki users to deliver anything worthwhile. I see that I've been wrong; there are some very good articles. (Male, PG)

Another student from the same cohort questioned how collaboration could occur:

> If people upload their page late (close to the due date) how I can edit it on time. I found that most of students write their assignment on MS Word first then later they upload it. I might not have enough time to do it. (Female, PG)

These challenges brought about by working in a wiki shift perceptions, although understanding of the roles of individuals, as both novices and experts, has not been taken in fully by students. This is exemplified by the following reflection:

> I guess people get nervous about change. People are afraid of the unknown. Not knowing what is going to happen. It can be pretty scary, and I'm sure most people have experienced a nerve racking time where they didn't really feel in control of their life. I think change is good. (Male, UG)

Other students also expressed some reservations about the wiki environment such as

> Initially I thought it sounded like a chat tool on steroids blended with web and file management tools, how naive I was. (Male, PG)

This demonstrates the shift in perception that students experienced as a result of interacting with their peers in the wiki. Further, students were able to transfer their developed knowledge of wikis directly to the workplace:

> What I take away from this course is more than the technological aspect of wiki utilisation; it is the broader aspect of change which is deriving from new processes, encapsulating new concepts around communication and knowledge administration. As we know, knowledge is information in action and with these new tools like wikis

> and blogs, we are able to create more knowledge due to changing the process of interaction with information. After doing this course I am now fast tracking the implementation of a wiki at my work. (Male PG)

This demonstrates the ways in which students have taken up the processes afforded by wikis. At least two organisations have had wikis implemented as a result of students championing wikis at work. The ideals of community and collaboration appear to resonate with students in such a way that meta-learning and a shift about deeply held assumptions about collaboration can take place.

Community and collaboration

For some students, the wiki became a virtual classroom, with many of them using the shoutbox feature (as noted above) to chat to other students who were co-present in the wiki (this was visible in the list of member currently logged in). While there was no chat room implemented within the wiki, this is something that may be considered in future. The ability of students to actively collaborate is important as demonstrated by their appropriation of the shoutbox for chatting about anything and everything.

> I had a lot of fun that while I [was] editing … I had some question want to ask, and I type my question on the shoutbox. There was a quick reply within a few minutes, which did solve my problem. I believe shoutbox is a very efficient tool for collaborative learning. (Male UG)

The immediacy of the chat-like feature lead some students to view assessment work in very positive ways:

> The assignment submission process was quite exciting. This was the time I realised how people are sharing information and ideas through "shoutbox" and through reviewing each others articles. (Male, PG)

Students recognised the power of the wiki to engage in collaborative work as demonstrated by the following:

> … wiki can be considered as the best learning tool for next generation of students, offering new ways of collaborative work and also independent research… (Male PG)

The dual nature of wikis enabling both collaborative work and independent research has the potential to engage students at deeper levels.

At the same time, students are recognising deficiencies in much of the research and information they encounter, particularly within *Wikipedia* but also in more formal readings from the course. For instance, a non-English speaking background student gave the following critique of Lave and Wenger as part of their reflective journal:

> The reading "Communities of Practices" bring me a concept about that learning process involves achieving individual and communal goals. We, as each individual, everyone is part of the community. Everything we contribute to the community will have / can affect the value of the community. However, some critical notions have been missing in this article, such as ethic of care and strategic thinking (Liedtka 1999 [sic]). "Communities of Practices" can be suggested to participated learning and contributed sharing that can progress both the individual and the collective's capabilities. (Female, PG)

This reflection demonstrates the power of the wiki to engage learners in deeper practice reflecting the values of community practice.

Community values

Students viewed the wiki as practical, anti-authoritarian, and based on sharing knowledge. In the case of MWT, the students learned as they used and then reflected on how meaningful and practical the wiki experience was. This process can only be described as a pragmatic experience where knowledge is shared and 'constructed'. As noted by one student

> I learnt how collaboration of work makes thing easy and gives many angles to an issue so that an in depth analysis can be done. (Male PG)

This demonstrates one of the key ideas: collaboration and collectivism allows multiple perspectives and deeper understanding to be constructed. This is achieved through the sharing of perspectives creating many interpersonal interactions as part of the process.

Many students felt the wiki was a good model for a learning environment and that the wiki helped develop their learning skills in positive ways. Students seemed to be rather reflective of how the wiki functioned in their learning. For instance:

> Unlike web logs, wiki pages are rarely organised by chronology; instead they are organised by context, by links in and links out, and by whatever categories or concepts emerge in the authoring process. I noticed some entries were often incomplete, and creators may deliberately left gaps open, hoping that somebody else will come along to fill them in. (Male, UG)

This student showed how the tool prompted the desire for more collaboration but the social interactions of the classroom environment hindered them. 'Deliberately left gaps' hints as having more people involved and 'engaged' in the wiki way of thinking than the student expected. This kind of reflective practice is often not a skill that all students are able to develop in a traditional classroom. However, in both the content and the structure, students appeared to be engaged with the possibility of the wiki and how this impacted upon their learning. It also highlights issues around the perceived lack of focus in this non-traditional environment.

Student perspectives

The perception of a lack of focus relates specifically to other students posting apparently superfluous material, the organisation of the wiki and the need for more cooperation (joint assignments) to assist in work completion. The issue of focus in wiki work is partly due to the framing of the course as an investigation into mobile technologies with fuzzy requirements that relate more to the format of the submission than the content. Providing students with wide opportunities to engage with particular technologies and processes that intrigue them is a central feature of the course. That some students find this disconcerting is perhaps indicative of the success of the framing and the change in epistemological standpoint for students in the course. Other students identified this as a positive feature, with one student commenting that the course

> didn't have the traditional "group project", rather collaboration through a wiki – very clever. (Male, PG).

While the requirements of the course are rather broad, suggestions by students during the course led to a page that could function as a table of contents by which students could coordinate activities. Future courses will provide this at the beginning of the course, thus allowing students who need focus to find it, while still allowing students to collaborate and investigate in multiple ways.

Another issue identified by students was the time to learn how the wiki works. The first assignment is focused on developing these skills, but is yet to provide the full realisation of this process. Many students appear to be overwhelmed by the large number of functions available in *TikiWiki*.

> I think using wiki is a good idea as a learning tool, but I think there are some drawbacks which are not easy to use. For example, I think wiki is not a user friendly tool, sometimes I have to spend some extra time to look a function. Moreover, not all functions can support HTML, so I have to learn another new tag which only support for wiki. The wiki tag caanot display results which I expected than HTML tag. Undeniable, wiki is an innovative idea to use in our course. Everyone can share their idea or knowledge by using this tool. (Male UG)

This was evidenced by many students creating multiple versions of artifacts (eg pages, blogs, etc) rather than editing or posting to single spaces. This perhaps relates to the students' concern about 'superfluous' material. Future courses will provide for the first few weeks to be focussed on developing wiki skills with limited permissions until students pass a quiz certifying them 'wiki able'. This is similar to the process employed by *WikiEducator*, which provides a structured set of tutorials to engage learners (in this case educators) in return for collaboratively developed content. Whilst keeping with the philosophy of the course, this would contribute to their grade once they achieve competency. Students will thus develop some understanding of the wiki prior to being given full access.

Two issues arise from this. The first is the need for structured development of skills in an open format, while the second issue relates to the development of a stronger focus on the core knowledges being developed. In some ways, the openness of the platform leads to a frenzy of creation, which can only be channelled by more structured approaches.

Discussion

Learning in a wiki environment: Different philosophical assumptions

Students actively created a community. They were engaged in the community building processes in contrast to traditional notions of assessment, which looks to the product of learning. The course develops into both a community of inquiry (Garrison & Arbaugh, 2007) and a community of practice (Lave & Wenger, 1991) around the notion of developing a central repository of information.

Ruth (2004) claims that both the social and physical environments are held to actively mediate learning through co-locating individuals within a mutual space. This is particularly the case with the wiki environment as students not only come together in a mutual physical place (the classroom), the wiki becomes a mutual virtual space which not only shows asynchronous interactions but allows students to interact synchronously through the visibility of activity via the 'who's online' membership list.

Opportunities to engage in knowledge building occur frequently as students watch their peers engaging in other knowledge construction activities. These forms of conversation are almost vicarious in nature (Ruth, 2004) as direct interaction is not required for students to build on other's knowledge. The wiki becomes a space for interpersonal interactions where learning and sharing of knowledge occurs between individuals – novices and experts (Vygotsky, 1978).

Wikis blur the definition of both novice and expert as expertise is developed and constructed as part of the process. While an individual may be a novice in one area, they are able to develop expertise, to varying degrees, in others. Thus, the focus on the learner's activity in a social environment is foregrounded similarly to Rogoff (1990), who uses Vygotsky's socio-historical perspective of placing mind in society in central focus, and shows that

> … the basic unit of analysis is no longer the (properties of the) individual, but the (processes of the) sociocultural activity, involving active participation of people in socially constituted practices (Rogoff, 1990. p14).

Wikis, by their very nature, are a 'socially constituted practice', blending novice levels of knowledge with expertise.

Communities of practice

Within the above framework, wikis allow students to engage in processes that develop socially situated knowledge through collaborative practice facilitated by technology. This allows teachers to embed opportunities for students to collaborate in technology facilitated learning environments and constructively align learning processes with learning outcomes, that is, engaging with disciplinary knowledge construction that is also assessable work.

Lave and Wenger's (1991) "communities of practice" philosophy is helpful for investigating wiki learning processes. Their main thesis is that learners work within communities of practice and that "legitimate peripheral participation" helps to describe the relations between newcomers (i.e. novices/students) and old timers (i.e. experts/teachers) so that "learning is an integral and inseparable aspect of social practice" (p31). These processes and outcomes are directly associated with learning. The emphasis is on the 'whole person' acting in the social world. Their perspective articulates an:

> emphasis on comprehensive understanding involving the whole person rather than 'receiving' a body of factual knowledge about the world; on activity in and with the world; and on the view that agent, activity, and the world mutually constitute each other. (Lave & Wenger, 1991 p. 33)

The course thus becomes a 'community of practice' in the broad sense. The students are actively engaged in the construction of a 'text' that binds them into the community. They are all contributing to each other's learning and thus are becoming members of a community of inquiry. Shields (2003) discusses the definition of a 'community of inquiry' as being focused on a particular 'problematic situation' which is the catalyst for community formation. In the course, the catalyst is, in part, the lack of a defined textbook and the desire to have the latest information. This sets students to investigating a whole range of technologies before deciding which will be the focus of their contribution. In this way, students are able to define a sub-problem and

collaboratively work with other students to create their 'text'. They are becoming experts to other novices while also being novices to other experts.

Pedagogical considerations

Kimber and Wyatt-Smith (2006) describe students as designers of innovative representations of knowledge, meaning that students engage as 'designers' (or co-designers) of knowledge. This process incorporates the acts of "pausing, reflecting and designing multimodal representations of knowledge" within a digital environment (Kimber & Wyatt-Smith, 2006, p.25). The MWT wiki positions students as co-constructors of knowledge as well as co-designers of the learning environment.

As noted above, traditional textbooks create problematic situations for courses such as *Mobile Workforce Technologies* as technologies evolve over relatively short periods of time. This means that a textbook is already out of date when students receive it. To overcome this, the concept of students as co-designers and, consequently, as co-constructors of knowledge, was embedded within the course and allowed the development of a 'student constructed textbook'.

Active participation and egalitarian learning

The MWT learning environment provided an epistemically authentic environment. As the majority of students had never engaged with wikis, the collaborative and constructive processes are taught within the context of the course. This provides an exploratory environment where students are continually demonstrating new ways of doing things with their peers as well as pointing other students to other ways of interacting. The findings of this study point to the need for these collaborative and constructive process to be firmly embedded in the course, particularly where these are part of the desired outcomes, and they need to be explicitly stated and developed.

Valuable insights are now being gained into the understandings and perceptions of technology enhanced environment by participants (Thomas, Clift & Sugimoto, 1996; Soong, Chan, Chua & Loh, 2001; and Ruth, 2004) and about students (Hammond, 2000; Kear, 2001; Thomas, 2002) and teachers (Mazzolini & Maddison, 2003). These include findings that status hierarchies exist between the postings of students and teachers, with many students placing more value on postings from teachers (Thomas et al., 1996). Status hierarchies negate the social co-construction of knowledge – the reciprocal process of interaction between people – because co-construction is generally theorised as between peers (Lawrence & Valsiner, 1993). The higher status placed on teacher postings means that there is a danger the learning environment might revert to a novice-expert interaction with little peer interaction, as in didactic face to face teaching.

Wikis disrupt status hierarchies and the environment evolves to the point where status is based on activity, rather than role. Soong et al. (2001) found the technical competency of teachers and students, and the collaborative potential of a course to be critical factors for the uptake of electronic resources and interactions. In MWT, gaining technical competency is part of the process. Thus these research findings challenge some of these insights with the wiki learning environment being more epistemically relevant due to the unknown nature of evolving technologies and the early admission by the teaching team that there is no suitable, up to date text for the course.

Wiki collaboration can be seen as an ongoing conversation as students constantly update pages based on interactions in face to face sessions, research online and reflecting on the work of their peers and the teaching team. These interactions potentially deepen the level of intersubjectivity or shared understanding (Wertsch, 1998) achieved in the course. This was demonstrated through student reflections.

The wiki philosophy of learning

Ruth (2004) found that students engaged more with the learning environment when it was framed as a more authentic environment, that is, there was a valid pedagogical reason for engagement, rather than simply 'busy work' and that assistance from peers and teachers would be forthcoming. This is similar to Valsiner (1994) who views individuals as co-constructors of knowledge rather than mere recipients of socially derived knowledge. Wikis allow the engagement of students at a point of co-construction rather than re-construction through traditional assessment practices. Ruth (2004) highlighted the "notion of dialogicity, through conversation, and the epistemic authenticity, through epistemically relevant tasks" which is also relevant to a wiki environment. The history pages provide a glimpse into these conversations between students and their teachers.

The wiki epistemology

Wikis are based on the concepts of interpersonal interaction in which users can argue, negotiate and provide thoughtful critique (Vygotsky, 1978; Ruth 2004). This negates the typical academic expert approach and instead suggests an interactive participative platform for sense making, knowledge sharing (Augar et al. 2004), and an eclectic egalitarian learning process. Students realised the potential of an encompassing environment that facilitated a product and process view of knowledge, providing a sound basis for further pedagogical developments within this course.

As previously stated, wiki development is born out of a frame of co-creation derived from open source culture (Lessig, 2004), with an epistemology based on sharing, collaboration and co-creation. A wiki is not simply a tool to achieve a goal but an epistemological device. By this we mean, that knowledge is formed by the individual as a process rather than a product that is presented by them. Being a process, knowledge is always 'in formation' rather than 'already formed'.

The wiki epistemology therefore has several important characteristics:

- collaboration – individuals acting together to develop shared knowledge;
- construction/co-construction – individuals acting together to produce knowledge and their products (in flux);
- different ways of learning – individuals acting together as equals – sometimes an expert, sometimes a novice, rather than in competition;
- the authority of 'the' expert is undermined; and
- a different philosophical underpinning which is more oriented towards constructionism.

Collaboration and construction/co-construction are useful where definitive knowledge is not available, or where processes are in stages of development. Wikis allow for this evolving knowledge base to be developed by the community members. This inherently leads to more equitable modes of interaction as all participants are seen

as engaged in authentic learning (Nystrand, 1997) and that even the leader may not have all the knowledge that is required. The philosophical underpinnings are the basis for the case elaborating these wiki characteristics using a course on mobile workforce technologies. According to Nystrand, epistemic authenticity relates to whether there are 'prespecified' answers to questions, the absence of which allows for deep engagement by the student. Valsiner (1994) also highlights the co-construction of knowledge, rather than merely receiving it, which also indicates epistemic authenticity.

Conclusion

Wikis allow for shifts in perspective around collaboration, construction/co-construction, different approaches to learning, and different philosophical underpinnings (i.e. more oriented towards constructionist models of inquiry/learning), where the authority of the expert is undermined (Metcalfe, 2008). This allows wikis to be seen as epistemological tools rather than ontological tools, that is, they help elaborate 'how we know' while documenting 'what we know'. Wikis foster a deeper style of learning that is more collaborative, reflecting and cooperative than traditional 'competitive' assessment. They are by nature anti-authoritarian, socially constructed, role shifting spaces that are used to create 'shared knowledge'. In particular, they can be used to build pathways to competency, which represents the greatest challenge to academics wishing to apply the technology.

The challenge we have is that the traditional approaches to learning environments are based on a criterion of competitiveness, which is often viewed as the antithesis of the 'collaborative' environment. In a collaborative environment, the roles change. Students are no longer just competing for the highest grade; they are comparing and contrasting their work for the sake of making sharable knowledge. A framework that assesses this should encompass the pragmatic elements of collaboration as well as the demonstrated learning outcomes by each student. The greatest challenge to developing a pedagogical framework is how to encompass a meaningful criterion that effectively measures learning in a non-competitive collaborative environment. Learning how to understand the change of perspective in the student and how to capture that as a 'reflection' is part of the ongoing development within the MWT learning environment.

Wiki pedagogy thus entails the following dimensions

- opportunities to develop competency in the skills required through an apprentice style beginning;
- an open framework of (inter)disciplinary knowledge;
- multiple pathways for entering, learning and building the wiki content;
- recognition that it is never finished;
- understanding and accepting both competition and collaboration/cooperation; and
- emphasising the potential for perspective shifts.

Future research will further investigate these deeply held assumptions about work and learning and elaborate how these challenges to epistemology and ontology can be better understood. As the previous section argued, there needs to be a better understanding of how to incorporate 'wiki thinking' into more traditional curricula because it challenges core assumptions.

Perhaps the best argument for using wikis in learning environments and the most succinct statement of the pedagogy is the following statement by a student in the class:

> Best way to learn is to learn from each other while we grow together.

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