

Four Vignettes of Learning: Wiki Wiki Web or What Went Wrong

Author

Ruth, Alison, Ruutz, Aaron

Published

2007

Conference Title

Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2007

Rights statement

© The Author(s) 2007. The attached file is posted here with permission of the copyright owners for your personal use only. No further distribution permitted. For information about this conference please refer to the publisher's website or contact the authors.

Downloaded from

<http://hdl.handle.net/10072/29121>

Link to published version

<http://www.aace.org/>

Griffith Research Online

<https://research-repository.griffith.edu.au>

Four Vignettes of Learning: Wiki Wiki Web or What Went Wrong

Alison Ruth
Aaron Ruutz
Griffith University
Australia
a.ruth@griffith.edu.au

Abstract: This paper discusses some of the errors of judgment made in attempts by the authors to introduce blogs and wikis into teaching environments. It highlights the process of attempting to develop spaces for intersubjectivity to develop through technology-enhanced environments. The underlying aim of all the cases was to both introduce new technologies. Lessons learnt include the need for structuring assessment processes and that the technologies can support group work and potentially collaborative assessment.

Introduction

This paper discusses four cases of implementing new technologies in tertiary courses. The underlying aim of all the cases was to both introduce new technologies to and connect with the so-called digital natives (Prensky, 2001a). Digital natives, Prensky (2001a:1) contends, “think and process information fundamentally differently from their predecessors”. This implies that these students work and live in a “twitch-speed, multitasking, random-access, graphics-first, active, connected, fun, fantasy, quick-payoff world” (Prensky 2001b:5). They share information differently, perhaps they *do* think differently.

Because we know the world is changing, restructuring of what it means to teach and learn are being sought. An interest in technology and recognition that the world’s informational stage is changing, through wikis, blogs, Youtube and Google allow us to investigate the development of intersubjectivity or at the very least, interactional opportunities for students, through the use of technology enhanced learning.

Newman, Griffin and Cole (1989) held that intersubjectivity is achieved over time through interpersonal interactions between individuals, through discussion, through questioning. Each form of interaction may consist of negotiation between the individual and the social, that is, both the knowledge to be learnt and the social environment in which it is presented (Newman, Griffin and Cole, 1989). Blogs and wikis provide a social environment for interactions. Intersubjectivity evolves most strongly through face-to-face, interpersonal interactions (Rugoff, 1990, Wertsch, 1998). However, in technologically mediated settings, some of the personal aspects of face-to-face interactions become lost, which result in different possibilities within computer-mediated environments (Sofia, 1995).

There are many technologies that have been developed that assist in the sharing of information and hence the development of knowledge and in some instances, intersubjectivity. Since Tim Berners-Lee wrote the specification for the World Wide Web in 1989 (Berners-Lee, 1990), many different ways of using that specification have developed. Many of the applications currently being developed work closely with Berners-Lee’s vision of “space for sharing information” (Berners-Lee, 2005).

Both wikis and weblogs (or blogs) allow for the creation of shared understandings of topics to be developed. The concept of shared understanding, or intersubjectivity, has long been used as a guide for education (Newman et al., 1989), that is, the student will come to share the knowledge of the teacher.

However, certain differences occur between blogs and wikis. Many blogs are written with a particular ‘voice’ being employed, the voice of the expert. While blogging and journaling are different (Ruth, 2006), there is a conflation of the two concepts into the technology. The technology (that is any one of the many blogging

applications) allows the ideas to be aired and shared and, in the majority of cases, comments to be made and conversations to arise.

Many people seem to view blogs as a more presentational forum, that is, a space for an individual to 'present' their views for the consumption of their audience. This harks back to the 'armchair philosopher' but some very interesting interactions occur when the 'blogger' seeks to develop intersubjectivity with their readers. This usually occurs through the interactions within the comments. Many a blog entry is modified to incorporate information and ideas that commenters have proffered. Like academia, these comments are acknowledged in myriad ways, within an edit to the entry or within a subsequent entry.

The weblog, or blog, developed from early efforts to maintain a log of pages visited on the World Wide Web (see Rebecca's Pocket <http://www.rebeccablood.net/archive/1999/04.html> for an example of the early development of a weblog). Since those early days, tools such as Del.icio.us (<http://del.icio.us>) and CiteULike (<http://www.citeulike.org>) have developed to maintain these records. Blogs are more often now often used to journal activities in the sense that an individual may update their blog or journal with their daily activities and many other aspects of their professional and personal lives as well as research interests and progress. Specific use of blogs can be made within education as a space for reflective journaling of work and learning undertaken and learning processes engaged in.

According to Rebecca Blood's *weblogs: a history and perspective* (2000), the definitional criterion of dated entries was established in early 1999. But further than that, Rebecca Blood described the early original blogs as link driven sites, that is, they consisted of links, some commentary, and personal thoughts and essays. This has evolved to numerous forms of blogs, including semi-private journals (as found on LiveJournal <http://www.livejournal.com>) and community blogs (like Crooked Timber <http://www.crookedtimber.com>). Some blogs maintain the original focus on pointing to and discussing other web pages while others are more reflective demonstrating the expansion to spaces for intersubjectivity (shared understanding) to develop.

Wikis are websites that allow many people to create a web of pages, sharing ideas and understanding of topics. Unlike blogs, Wikis provide a space for the ongoing development of concepts within a single page. Whereas blog entries tend to flow off the end of the page, wiki entries are almost always available and generally have a static location within the wiki web. Many blogging applications provide for static reference to entries through the provision of 'permalinks' (permanent web links), however these are often arranged within archives with chronological references. Wiki entries maintain their availability through links between pages, through the 'small pieces, loosely joined' (Weinberger, 2002). Linking between pages represents the fundamental difference between blogs and wikis. Wikis are designed for inter-linking pages, and hence the development of a space for information, while blogs focus on the sequence of information, particularly as it attracts the blogger's attention. Both interactional forms have significant potential for education although structuring the learning processes around the technologies requires some forethought.

For instance, blogs allow the journaling of a learning process, almost a record of the journey through a new area of knowledge. Using the ability to classify entries by topic, they can become a record of what processes an individual engages in while learning. Wikis allow the ongoing development on a topic, sometimes in a single page, sometimes in a set of linked pages. Wikis, like blogs, have a historic aspect which is often displayed in the history of each page. These aspects allow the beginning of intersubjectivity to occur.

Thus, these technologies allow both a process view of learning as well as a product which may form part of the assessable items for a course of study.

Case studies

The four cases presented here, represent a historical development of attempts to integrate technology in learning. In some ways, these cases approximate a series of blog entries around each semester and course. The authors (Alison and Aaron) present their cases in chronological order, the period of which covers nearly two years.

The first case was an almost accidental implementation of blogging technology in a class. It involved a small group (4 students) and multiple ways of interacting. The second case involved a more formalized project to

implement a wiki in a technology-oriented course. The last two cases represent the culmination of these early attempts, with the technology (wikis) becoming a central feature for large numbers of students (80 in case 3 and 550 in case 4). Each author presents their experience in their own voice, to reflect on the process. This is particularly important as Prensky (2002b) notes that reflection is one of the key areas that many 'digital natives' do not have sufficient opportunities to undertake.

Case 1 – Blogging for the small group. (Alison)

As part of a restructure of degree programs at an Australian university, the last offering of a course in e-commerce had a cohort of 4 students. The course was scheduled for a Friday night and all members of the cohort worked at a relatively significant distance from the university, which made traveling to the campus problematic. While each student was able to attend, at our first meeting we discussed options for maintaining interaction without attendance. The students were in agreement that technology facilitated interactions would be preferable to attendance on a Friday night.

During our first class, which was to be devoted to introducing the course, the assessment items and requirements for the course, we discussed a number of different options for interaction. The blogging service *LiveJournal* (<http://www.livejournal.com>) was introduced as one option because it enabled interaction restricted access to postings based on the concept of 'friends'. Friends in LiveJournal vernacular equates to readers of the journal, to the audience. LiveJournal also allows the restriction of readership to co-friends or subsets of 'friends'. This allowed for the students' privacy to be maintained and for them to communicate semi-privately.

There was also the option of meeting with me during the normal Friday night session as I was always on campus at that time. Instant messaging details were exchange at the initial discussion to allow multiple ways of access to be established. This was in addition to the generally accepted methods of visits, phone calls and email.

While the students' achievement in the course was high, based on the criteria defined prior to the commencement of the course, the interactional aspects were ill-defined with students making contact on a needs basis rather than a regular basis. One of the problems which became evident early was the lack of structure to the interactional options. As the students all worked in management positions, they represented the precise group which Acker (1995, online) described as "travel-irritated citizens caught in time poor conditions but blessed with resources to cover distance with telecommunications". This resulted in limited interaction as a group, although the variety of personal interaction enabled, students were able to impose their own structure as needed.

The lesson learnt from this course is that interactional media needs a specific purpose for its use to be taken up by learners. This is consistent with the findings from Ruth (2004) that educational opportunities using technology need to have a clear purpose for their uptake. Another approach would be to mandate participation, although, again, the purpose for the participation and for making it mandatory needs to be explicitly linked to the designed outcomes for the course.

Case 2: A small group in fully functioning wiki (Alison)

As a part of a fellowship offered for innovative learning and teaching projects, a full wiki was implemented for a post-graduate course in new technologies. As the course was technology focused and the purpose of the course was to introduce students to technologies, both new and old, the implementation of a wiki in this course was an almost natural progression of the learning environment. This echoes the notion of legitimate peripheral participation as suggested by Lave and Wenger (1991), in which participants engage within the community of practice in which they work. Students engage in learning within a technology enhanced environment to learn about technology enhanced environments.

The wiki used in this course was TikiWiki (<http://tikiwiki.org>) which is used by many educational institutions around the world (see <http://edu.tikiwiki.org>). This is a feature rich wiki with many features that can be used within educational settings, as demonstrated by the WikiMatrix (<http://www.wikimatrix.org/>) and the feature matrix in Wikipedia (http://en.wikipedia.org/wiki/Comparison_of_wiki_software). The wiki allowed for the development of shared spaces relating to topics on mobile technologies.

This course was structured with an assessment item planned around the potential of wikis to enhance collaboration between participants. The wiki assignment required students to create at least one page on a technical issue and create at least one page on the social or business aspects of mobile technologies and participate in the development of at least 2 more pages in this latter group.

What did I expect when I set out to get students to use the wiki? I don't think I really expected much. The minimum they had to do was create two pages and write at least 1500 words in the wiki (this for 40% of their grade). The two pages consisted on one technical page and one social/business application of technology page. I figured this would be a fair assignment, not requiring much effort, yet getting them involved in both learning processes and creating learning outcomes. They also had to journal their experiences of the wiki with some reflection on their learning (15% of their grade). The third aspect of assessment was a form of participation and was to be extracted from the wiki. Participation in this case included every login, every update, every comment, private messages, blog posts, whatever they actually did. It gave a measurable value to their participation, something that I knew I could point to as 'hard evidence' of participation rather than the sometimes vague and subjective measures of classroom participation in face-to-face classes (this was an attempt to overcome student perceptions of participation measures as simply 'being there' as students appear to conflate participation and presence). The only thing the wiki did not log was their movement around the site, what they read, etc. This would have given a clear indication of their vicarious participation/interaction (Ruth, 2004) which is clearly different from the more active forms of participation that we grade.

The expectation of at least two pages to be created per student seemed manageable, given that actually assessing the pages was something I had no idea how to do at the beginning, particularly given that I needed to be sure what each student was responsible for.

However, instead of 60 pages, there was approximately 160 pages. Not all of the pages were good content and there seemed to be a tendency for students to 'own' them by signing them or in some way linking them to their perceived notion of output. Assessing the pages became a real headache as some were edited by only a single person while the most active page was edited by 20 students. Clearly, there was significant differences in what was being produced.

The wiki was difficult to mark, given that a number of students sought to gain a HD by putting in extra effort which resulted in students creating more pages rather than giving attention to detail on individual pages. In effect, the approach taken by students reflected a quantitative approach to work rather than a qualitative approach. Only by taking into account the marking criteria and modifying it to account for the high level of commitment shown by some students was the marking of student work able to be completed. Marking the wiki work took two people using 3 computers 3 days to complete. Each marker used a computer to access the work on the wiki as well as the extracted information that was being marked, while the third computer was used for recording marks. The third computer allowed us to maintain a single file and reduced the need to collate marks on completion. Instead of marking individual student contributions, each pages was assessed both in totality and for individual contributions.

The sheer volume of pages created by the students added significantly to the process of awarding marks. Not all of the work met the standard suggested by the assessment documentation, although without forethought, all pages were up for assessment. Many of the pages were more indicative of attempts by students to explore the technology and perhaps should not have been included in the assessment.

The lessons learnt from this course were that students will often surprise you and that not all work that students do, even within a wiki, should be part of their assessment. Changes which would facilitate both the learning processes and the assessment processes would include

1. emphasising quality over quantity to students
2. requiring students to nominate their best work
3. providing more limits on what pages can be developed and still count towards assessment.

Case 3: a limited wiki experience. (Aaron)

The third and fourth case follow directly from Case 2 and use the idea of a limited wiki (specifically the Teams LX building block in Blackboard) to develop student assessment. This was implemented in a number of

different courses at both undergraduate and postgraduate levels (Case 4). Students in these courses were typically in their first year of study in their current course.

The first implementation of the Teams LX building block in Blackboard occurred in a shortened 'summer' offering of a non-technical course with most students being from a non-technical study background.

The employment of a wiki tool that fostered virtual collaboration was initially seen as a positive mechanism to create an efficient and flexible learning environment. Being a five-week course with approximately 80 students, the management of learning and assessment was an intense activity. For students, the short timeframe and significant depth of assessment was a demanding management task. This opened up the opportunity of using the wiki as a valid alternative to traditional session-by-session tutorial assessment items. Also rather than just being an assessment item, the wiki site created a 'rolling' resource for students to access as they wished throughout the semester, acting somewhat as a virtual textbook to support traditional classes. Running two lectures and two tutorials a week, the idea of having the wiki as an open collaborative 'homework' and 'thinktank' site was attractive. The Teams LX function provided the suitable option to manage the environment. Employing a "what you see is what you get" (WYSIWIG) user-interface, the wiki required only a small amount of training to enable use, providing also a simple user-friendly instrument.

Student work within the wiki accounted for 20% of their assessment and replaced the in-class assessment of collaborative exercises. Students were required to complete 4 of the possible six items with a maximum of 200 words each submission. Students were able to work individually or as a group to complete a larger collaborative piece with other students. Students were motivated to be creative with their submissions and able to for example link to websites, personal or web based files including research articles or other documents and upload pictures.

Unfortunately although the collaborative side was seen as the richer opportunity to develop interactive learning, it was rarely taken up. This may be due to the intense short-term nature of the course i.e. focus on more heavily weighted assessment and was supported with the student feedback.

Students had a four-day period from the initial questions being posted to make a meaningful contribution to the wiki discussion. However after this stage students could edit their submission until the final cutoff date for wiki submissions at the end of semester. The assessment process focused on student's ability to make effective use of the Wiki, and allowed assessment of how well they addressed the topic and the originality of their submission.

However, many students preferred more directive assessment and were quite intimidated by the open nature of the wiki. The marking criteria employed was necessarily flexible to allow for an open interpretation of students' work. It was difficult in most instances to quantify their work while measuring for quality. This was quite difficult to explain to students at the beginning of the semester, as many had no prior experience with wikis.

Being a non-technical course with many students from non-technical backgrounds, the first response to the wiki was somewhat cautious and many students displayed initial resistance to the concept. With this potential problem in mind two trial assessment items to be first attempted in the first week eased the students into using the wiki. Quite interestingly the uptake of the practice assessments was quite low, suggesting that students felt they could use the wiki without practice.

An interesting outcome of the wiki was the 'snowballing' nature of the tool. The initial use of the wiki was quite conservative and limited. However as the early adopters employed the available tools and developed creative submissions many other students followed much more quickly. Upon trying similar techniques followers developed a comfortable relationship with the tool and each other as members. As the exercises moved on this became more apparent and was supported by student feedback.

For the instructor, whether to act as an active or passive member of the learning community was an important decision. In this course, a passive position was taken, contributing as necessary during the submission process rather than driving the discussion. This allowed students to become creators of their own knowledge (Kimber and Wyatt-Smith, 2006). The wiki exercise was designed to aid students in the development of ideas for their research assignment and as a study tool for the exam. Many students expressed a positive view on this and found that the wiki was quite useful as a supportive learning tool for the entire semester.

The lessons learned from this first implementation of the TeamsLX tool in Blackboard were:

1. Collaboration appeared to be underdeveloped by the individual nature of the assessment.
2. More emphasis on group-focused work may need to be implemented to develop collaboration.
3. Skills with wiki tools need to be developed to enable more meaningful, collaborative submissions.

Case 4: Large groups in small wikis (Alison)

Following from the summer implementation, the Teams LX wiki was implemented across two courses at undergraduate and postgraduate levels. The undergraduate course was a first year business information systems course. The postgraduate course was similar in content although there was the inclusion of an introductory level of knowledge management. The postgraduate course was offered at two locations (campuses approximately an hour drive apart).

The courses were taught in a very similar manner although each course had a distinct course site. The undergraduate course had approximately 396 students while the postgraduate course had 125 at Campus A and 67 at Campus B. The two postgraduate courses were 'joined' in the Blackboard CMS to allow for some interaction across campuses and to facilitate ensure comparability of teaching processes.

These courses were a full 13 week semester with the wiki exercises accounting for 24% of the students' grades. Students were required in this course to answer 3 of twelve questions across three levels of difficulty (one question from each level). Students were able to work collaboratively but each student had to submit their own contribution. The wiki facilitated building on previous submissions, although the apparent uptake of this was minimal.

Students were assigned to a wiki based on the tutorial group they attended so there was both a face-to-face and a virtual aspect to the work. There were 8 tutorial groups and 18 groups at undergraduate level. This design allowed students ample opportunity to answer any question, without too many responses restricting possible approaches taken by students. It also allows for tutors to get to know the students in their groups and provide a more manageable marking process to be implemented.

As the final submission date for this larger group is after the closing date for this conference, only initial impressions will be reported. These impressions are based on the activity in the wikis as indicated by the history of each page and general feedback and questions posed by students.

As opposed to the short wiki course, this course had no set commencement dates, with students required to finish all three questions by a certain date. Early indications were that very few students attempted the submission prior to week leading up to the final submission date, although there was more early work in the postgraduate group than the undergraduate group.

Some concerns were expressed by some students that as each group could not see other groups prior to submission, that there was 'rumours' of students between campuses 'sharing' answers. This aspect creates a potential problem as the subsequent exposure of group answers to all students may lead to potential conflicts between students. However, it was made clear to students that all wikis would be available and we plan to proceed with this.

A process was designed to enable each tutor to mark their students' wiki submissions with minimal navigation through the wiki so that individual contributions on each question's page were the fundamental unit being sought. Each page in the wiki is likely to have contributions from 2 to 4 or 5 students depending on the size of the group and the proclivities of the students.

These course did not have mandatory start times as many students are enrolled in multiple courses (unlike during summer courses where the offerings are fewer) and there is a policy of not having many submission requirements. However, the differences in the participation rates between the summer course and the normal semester course may require rethinking what we think is submission. In some ways, perhaps offering bonus marks for early commence may overcome the reticence of students and the potential for overwhelming the system on the

due date. As a wiki each page is only editable by one person at a time, this may restrict students ability to leave things to the last moment.

Again, for the most part, the instructors and tutors took a minimalist position as passive participants although attempts to add extra layers of structure resulted in some confusion on the part of students. The nature of the assessment was to allow students to apply structure to an ill-defined problem which resulted in some students demanding structure while other students resisted any structuring of their allowed activities.

Lessons are still being learnt in this current implementation. We have only days to go before we close the wiki for student work. Longer semesters do not appear to enhance the level of collaboration being undertaken, with students only now starting to take it up with any meaningful activity. Perhaps a wiki is too challenging within a traditional university course. More reflection needs to be undertaken as we evaluate this course.

Opportunities for development

Some of the lessons learned in these courses will provide a foundation for the uptake in many other courses and disciplines with specific processes that may be implemented. Some of the mis-steps taken will provide a firmer ground for other instructors to attempt using newer, more collaborative technologies in their teaching.

Specific requirements identified through the current experience include:

- Provision of user manuals and documentation (possibly an online training module/activity)
- Development of the functionality - Image galleries; FAQ's; Page Rankings; File galleries
- Development of the ability to upload audio/video files
- Development of student multimedia content for submission

Processes for marking student work also need much forethought for each implementation as many courses have different aims and proposed outcomes for students. Each course instructor will need to evaluate what aspects of working with a wiki will facilitate the learning outcomes for their students in their particular course. This implies that not all courses will have educational outcomes that are consistent with what activities wikis and blogs provide. Other technologies may provide better potential outcomes.

The open-ended potential of the wiki is perhaps more appropriate for more advanced students, although we assumed that the so-called 'digital natives' (Prensky, 2001a, 2001b) would be more ably equipped to handle these new approaches. This does not seem to be borne out by our experience. Students seem reticent and not in possession of critical digital skills to enable them to move into newer forms of assessment, although this may be a feature of the Australian environment rather than the group as a whole.

Ways to assess student achievement and participation within the wiki is an ongoing struggle for instructors and may be shown to be a significant burden particularly with large classes. In particular, the main issue is that the open qualitative nature of collaboration within the wiki does make assessment design difficult and somewhat problematic. This raises the following questions –

- How can we employ and develop the tool to create a clear structured environment for students?
- How do we develop clear guidelines with clear structured criteria that allows students to achieve education outcomes?
- Does this structuring potentially take away from the power of the tool as an open collaborative mechanism?

These questions will be important for facilitators to address when designing the use of wikis, blogs and open forum technologies in their courses. In some courses the wiki may provide a relevant support mechanism in an open unstructured format. In other courses it may require a clearer set of guidelines and criteria. As the wiki is an flexible tool, the facilitator will need to make these judgments on a case by case basis. Further, as the supporting technology for wikis develop, a clearer picture of structure and uses for employment in courses may be possible. At this stage, it appears that wikis can be a support mechanism for collaborative work while also allowing for more structured assessment.

Other issues which need to be addressed include the development of the Teams LX tool to incorporate a process to query the wikis to extract individual student's work. This is available within a full wiki such as TikiWiki, although complete extraction of the data results in a rather large body of data. Having access to such a wealth of data may provide other ways of implementing assessment procedures as borne out by the full wiki implementation.

Overall we were impressed with the opportunities to employ the wiki in these learning situations. The tool has a positive future in collaborative learning environments. From the results of student use and management of the Wiki, and with continual development, it will grow as a relevant assessment tool. This is particularly important with continuing diversification of study programs, the potential to employ flexible learning and resource allocation processes. Wikis seem to offer vast potential which we will begin to fully evaluate as the current course (case 4) comes to an end.

However, more needs to be done to promote the collaborative aspect of the tool its potential for promoting group work could facilitate this. Two clear issues are raised. Currently the increasing demand for collaborative skills in university graduates is demanding innovative means to facilitate group work. Further, at present a demand is evident for developmental tools that can provide efficient and flexible opportunities to develop work. This suggests that promotion of tools such as the wiki for group-oriented work is vital to student learning and development. These are key features of intersubjectivity to develop.

Where previous cases have identified collaboration issues through use of the technology, it is evident that on these occasions assessment was designed at the individual level. From cases 3 and 4 it is shown that developing and supporting group work can successfully promote and increase collaboration.

There is real power in the tool as being a collaborative hub for ideas. We are entering an era where students have many open-ended opportunities to create their own work, the students-as-designers postulated by Kimber and Wyatt-Smith (2006). The design potentials could offer a new generation of students an exciting and progressive means of accessing, sharing and developing knowledge. Now we need to rise to these challenges.

References

- Acker, S. R. (1995). Space, collaboration, and the Credible City: Academic Work in the Virtual University. *Journal of Computer Mediated Communication*, 1(1). <http://jcmc.indiana.edu/vol1/issue1/acker/ACKTEXT.HTM> [accessed: 10 May, 2007]
- Berners-Lee, T., (1990) Information Management: A Proposal, <http://www.w3.org/History/1989/proposal-msw.html> [Accessed: September 3, 2006]
- Berners-Lee, T., (2005) So I have a Blog, <http://dig.csail.mit.edu/breadcrumbs/node/38>
- Blood, Rebecca. "Weblogs: A History and Perspective", Rebecca's Pocket. http://www.rebeccablood.net/essays/weblog_history.html 07 September 2000. 25 October 2006.
- Kimber, K and Wyatt-Smith, C. (2006) Using and creating knowledge with new technologies: a case for students-as-designers, *Learning, Media and Technology*, 31(1): 19–34
- Lave, J. and E. Wenger (1991). *Situated Learning: legitimate peripheral participation*. Cambridge, Cambridge University Press.
- Newman, D., Griffin, P. and Cole, M. (1989) *The construction zone: Working for cognitive change in school*, Cambridge University Press, Cambridge.
- Prensky, M., 2001a, Digital Natives, *Digital Immigrants Part 1, On the Horizon*, 9 (5), 1-6
- Prensky, M., 2001b, Digital Natives, *Digital Immigrants Part 2: Do They Really Think Differently? On the Horizon*, 9 (6), 1 - 6
- Rogoff, B. (1990) *Apprenticeship in Thinking: Cognitive Development in Social Context*, Oxford University Press, New York.
- Ruth, A. (2004). *Learning at the Screenface: A pentadic analysis of email discussion lists*, unpublished doctoral thesis, Griffith University, Brisbane.
- Sofia, Z. (1995) Of spanners and cyborgs: 'De-homogenising' feminist thinking on technology, In *Transitions: New Australian Feminisms*, Caine, B. and Pringle, R. (Eds) Allen and Unwin, St Leonards, NSW.
- Weinberger, D. 2002, *Small Pieces Loosely Joined: A unified theory of the web*, Basic Books: New York
- Wertsch, J. V. (1998) *Mind as Action*, Oxford University Press, New York.