

The use of wikis as a management tool to facilitate group project work

Tom Molyneaux

School of Civil, Environmental and Chemical Engineering, RMIT University, Melbourne, Australia
Tom.molyneaux@rmit.edu.au

John Brumley

School of Civil, Environmental and Chemical Engineering, RMIT University, Melbourne, Australia
John.brumley@rmit.edu.au

***Abstract:** Besides demonstrating technical competence across a broad range of engineering fields, Engineers Australia specifies a need for graduates to have acquired an understanding of project management techniques and an ability to apply them effectively in practice. The new civil and infrastructure engineering program at RMIT introduces first year students to project management and team work through group-based design exercises. This paper reports on the implementation of a group Wiki and its use to facilitate the project management and design process of an environmental design exercise. The design exercise and the characteristics of the Campus Pack/TeamsLX wiki extension to Blackboard are described. Besides improving student engagement in the projects, the Wiki was found to enhance the instructor's ability to observe (and guide) group dynamics and to facilitate timely feedback.*

Introduction

The course

There has been a movement in engineering and other professional disciplines towards problem (and project) based learning as an effective means of delivering the range of graduate capabilities required by industry, e.g. teamwork and communication, problem solving, autonomous learning, as well as technical skills. Engineers Australia is encouraging such an approach in its accreditation requirements (EA 2004) and consequently RMIT has made a substantial commitment to this methodology in the new programme in Civil and Infrastructure Engineering (Hadgraft 2003, 2004). The programme is proving successful with positive feedback from students, Engineers Australia (at the latest accreditation) and industry.

The New Civil and Infrastructure Engineering Program commenced at RMIT in February 2004 and has now run for three years. The program focuses on educating students on the whole of lifecycle performance of infrastructure (as opposed to design and construction) and on the responsibility of the engineer with regard to sustainability of the built environment. In particular the following were identified as the main goals (Hadgraft 2003, 2004).

- Develop the conceptual understanding required by a graduating civil and infrastructure engineer
- Develop the graduate attributes proposed by Engineers Australia
- Adopt problem (and project) based learning methods
- Engage students in the profession with a theme of sustainability

Environmental Principles for Sustainable Design (CIVE1186) is a 1st year course aimed at achieving these goals. It evolved from courses designed in the early 1990s to meet the need for environmental and sustainability literacy in undergraduate environmental engineering students (Brumley & Horan, 1995; Brumley et al, 2006). It now embraces a broader range of capabilities modelled on current

engineering practice and is a core course for first year Civil Infrastructure, Civil Infrastructure/Business Management and Environmental Engineering programs. It is also taken as an elective by other engineering and science students across the University. This diverse cohort of students has increased from 175 in 2006 to 250 in 2007. Students gain experience in conceptual design in a sustainability context through a series of lectures, tutorials, field classes and a problem based group project. In 2006, students chose one of several development proposals in Melbourne's Yarra Valley: footbridge, riverside restaurant, park development, ice skating complex, outdoor auditorium or night market.

In 2007 the course moved from semester one to semester two to provide students with the opportunity to first gain an introduction to basic engineering skills and to settle into the challenges of university life prior to undertaking a more major locally based engineering project. An exciting taste of engineering was given to the students in semester one through the EWB (Engineers Without Borders) project - a national design competition for first-year university students in which they focussed on the sustainable development of Uluru Children's Home in southern India. The skills developed in the EWB project were then built on in semester two with a topical engineering challenge facing Melbourne - namely securing Melbourne's future water needs in the face of potential climate change and strong population growth.

The State Government proposed four options. A coastal desalination plant; piping Gippsland drinking water to Melbourne in exchange for recycled water to Latrobe Valley Power Stations; piping water from the Goulburn Valley over the Great Dividing Range to Melbourne and harvesting stormwater. The Government chose the desalination and Goulburn Valley options which involve major infrastructure development and cost. The students were given the more sustainable option of stormwater harvesting which avoids major infrastructure development, embraces conservation rather than a consumption philosophy, has a close interaction with local communities for the benefit of those communities, is environmentally aligned with natural water systems and recognises the importance of urban catchments. Each group were given the freedom to select their own site and to develop individual group proposals/designs. The main learning objectives for this course are:

- Developing knowledge of (civil and environmental) engineering, including the role of sustainability principles in engineering
- Developing generic skills, including working effectively in small groups, problem-solving and decision-making, communications skills, accessing information, time management and goal setting

The project logistics involves group work in 7 tutorials with 250 students and requires a mechanism for facilitating strong communication between staff and students and within and between student groups for efficient sharing and optimisation of knowledge gained through the project. The wiki was seen as an ideal medium for achieving this.

The wiki in education

Wikis are widely accepted to have started in 1995 with the launch of creator Ward Cunningham's original wiki (at <http://c2.com/cgi-bin/wiki>). However for many it was the start of Wikipedia - the web-based, free content encyclopaedia in 2001 which resulted in the concept becoming widely known. Since then Wikipedia has grown rapidly into one of the largest reference web sites and wikis are now being used in all areas of collaborative work.

The potential for collaboration has driven educational usage with wikis being used throughout education from school to postgraduate work. There has been successful use of wikis in teaching since 2000 with CSL's (Collaborative Software Laboratory) use of CoWeb (Guzdial, 2001) and studies under the European SEED project (Schneider, 2002) exploring potential learning activities. In 2004 Schwartz surveyed the use of wikis in universities and observed that the majority of cases were adopting structured/guided formats for use on specific coursework rather than encouraging more generally personal use. She also observed that universities were rarely using them for administrative scheduling, faculty administration, provision of learning support materials, or course management. A thorough bibliography of wiki pedagogy is provided by Renee Fountain (2005). Lamb (2004) provides a summary of the essence of wiki technology that may be summarized as:

- An ability for anyone to change/create content using a simple 'hypertext markup' language
- Contributions are not anonymous, but content can become anonymous by virtue of multiple edits.
- The content/edits are timeless – not sequential (as in a blog)
- The content is 'work in progress' frequently with gaps and blanks

However, it is clearly apparent by exploring the various wiki formulations currently available that facilities/capabilities vary and there have been adaptations to suit a wide range of fields of work. In particular there have been developments in wikis to improve their suitability for group work and project management.

The wiki for project work

Wikis have been used to manage and guide project work in software development since the first implementations. EPS Software Corp. developed such a system in 1999 (EPS, 1999) to manage their projects. In particular their system facilitates management of product development and consultancy contracts. Particular features include allowing the client to see the progress of the product, constructs for creating 'to do' lists and structures to monitor product life cycle - identifying goals and requirements, establishing examples (cases), progressing the design and finally the implementation. A more widespread tool is the popular and freely available web-based project management tool Trac (Trac, 2007). Trac is an enhanced wiki and issue tracking system for software development projects. The system tracks tasks through timelines facilitating control and management of the project progress. It provides a document version control system - allowing users to keep track of changes made over time to any type of electronic data. The University of Sydney has used the system to assist group work in student group programming exercises and they have developed an add-on that provides feedback to the instructor on individual activity – in terms of setting and completing tasks and contributing to content (Kay, 2006).

Observations of the project based design course outlined above and other such teaching experiences over a 15 year history have highlighted the following issues with regard to assisting students to learn the organizational skills required of team work.

- The instructor finds it difficult to ascertain whether there is an effective group dynamic. Are all the members contributing and are they working as a team?
- The students find it difficult to keep a group identity/focus – because they tend to leave campus after timetabled activities, often undertake part-time employment and then work at home - frequently late at night and at weekends.
- The off-campus on-line working practice makes it difficult to progress group output/deliverables such as the presentations and the final report.
- The group can hide lack of effective working practice and progress from the instructor.

These issues are particular challenges for students and staff involved in group work on engineering projects in an education/student environment. In the workplace these issues are less challenging as there would be an office-centred environment and consequently there would be more personal contact. In addition, there would be a design file (or electronic equivalent) containing all meeting notes, technical data etc. All group members would have easy access to this file or management system.

Over recent years first year project-based exercises have included the extra deliverable of a group web site describing their project. This was originally introduced to encourage the development of web authoring skills – however it was frequently observed that generally only one group member developed such skills (or already had them) and s/he acted as web master – entering all data. The web page development however did have the beneficial spin-off effect of improving their team work. By looking at the web pages, as they developed, the instructor could offer feedback on progress. The students were asked to put on-line their project time-line and meeting notes, briefing papers from their research and then, as the project progressed, final report contents, draft sections etc. The web page became a management tool and a repository of their knowledge and output. Students' project management improved. Unfortunately the pages were often out of date because they had to pass on to the web master their individual contributions to be uploaded. In addition there were always issues in finding a host where the site could be seen only by staff and students – as universities are very

sensitive regarding such matters. Consequently many were developed on students' personal computers and shown at meetings but were not available on-line. With the growth in the availability of wikis – in effect a web site that can be edited on-line by each of its members - it was clear that this should be the next step and this coincided with a timely development at RMIT.

RMIT have been committed to using the Blackboard course management system for several years. The web-based system helps lecturers in their management of courses and gives students on-line access to their coursework material, offers facilities for assignment submission, grade book viewing, and discussion groups. The Campus Pack LX Suite (Learning Objects, Inc., 2007) is an add-on to Blackboard that is currently being appraised as a means to provide students with an e-portfolio and access to wikis and blogs. The wiki facility within CampusLX (the Campus Pack LX Suite) called TeamsLX has been the focus of the study reported here.

Implementation

In the light of the experience with student web sites, the objective has been to use the wiki as a tool for the students to manage the process of project management and for the instructor to manage the learning process. In an engineering working environment the process of project management will differ in detail – depending on company policy/facilities, individual manager characteristics etc. however there are common attributes that would be considered desirable in any such process. Typically one would expect such activities as planning and holding meetings, taking minutes, assigning actions, managing tasks in a timeline, following up actions, monitoring progress, guiding the design through from initial conception stage, cataloguing and filing documents, keeping track of document versions etc.

The implementation of TeamsLX has the following main characteristics that influence its effectiveness as a project management tool.

- Students and staff have to login to the Blackboard system - available on-line on and off campus to students enrolled in the course.
- Links can be made to any available object on the internet.
- The wikis can be configured by the instructor(s) so as to both allow access and to be visible to a sub-set of students selected from the class list.
- Purging of pages (permanent deletion) by students can be allowed (or restricted)
- Optionally the wikis can be open to all students for reading and commenting
- The wiki cannot contain blogs – the CampusLX implementation of blogs cannot be used to create a blog as an object within the wiki. However these can be created as separate CampusLX entities within the course or links can be made to external blogs from within the wiki.
- Page history is available to students with the facility to revert to any previous version (whilst keeping all versions).
- An analytical tool is available to the instructor(s) that assesses individual wiki member contributions (time and volume/size).

The students (total 250) were organised into 7 workshop tutorials each comprising approximately 7 groups of 5 students in each group. They were permitted to select their own groups. Each project group was given access to an initial wiki that had been seeded with a basic structure (Figure 1).

It was stressed throughout the workshops that this initial structure was just a suggestion and that they were free to change it as required to fit their working methods. The secondary-pages, linked from the home page, were as follows:

- JOURNAL – to contain day to day entries – a dialogue to pull together the thinking of the group, suggest ideas etc
- TIME PLANNING – this page was split into two – TIMELINE and MILESTONES. The Timeline page was put there for their Gantt chart (or equivalent) and the Milestones page was seeded with a table of milestones and subtasks (for each milestone). This table was initialised with several blank milestones and tasks and typical examples (Figure 2, discussed below).
- MEETINGS – an area to record meeting dates, agendas and minutes
- RESEARCH – for material collected, references, etc.

- DOCUMENTS – a repository for documents – including the final report
- PERSONNEL – contact details and/or links to e-portfolios



Figure 1: Management wiki – home page template

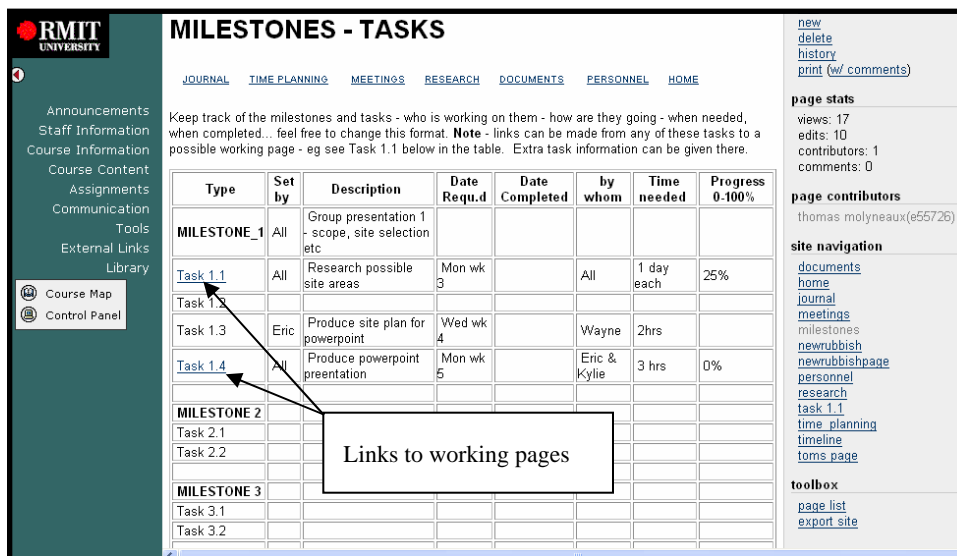


Figure 2: Management wiki – milestones page template

A key aspect of engineering project management is keeping track of tasks and timelines and it was originally envisaged that the Milestones page (Figure 2) would be used for this purpose.

It was suggested that the page would be the focus of their meetings where progress on each activity would be reviewed, key topics discussed in the light of such progress and resulting follow-on actions/tasks set. These tasks would be then entered into the table.

Observations

Progress meetings were held with each group at regular (weekly) intervals – during which the wiki was browsed. The groups showed a widely varied response to the wiki approach – with some groups (a small minority) apparently not using it for the first few weeks. However as a result of interaction in tutorials/workshops and group presentations it was apparent that the wiki content reflected very accurately each group's progress on the project – those exhibiting very little content had made very

little progress. A few wikis indicated that the bulk of content and activity was attributable to a few members – suggesting that the team collaboration was not ideal. This again proved quite accurate when followed up through a meeting with the individual groups. In a minority of cases it turned out to be due to unforeseeable circumstances – illness etc. however in other cases there were group interaction issues. Issues of lack of group cohesiveness were discussed with the particular groups and individuals. In general progress on the project seemed to improve following regular feedback.

There were two predominate methods used by the groups to organise their workflow. The majority used the method that was initially suggested – that is driving the progress through the table of milestones and tasks. Several other groups however chose to write detailed minutes and to identify tasks within these on-line minutes and link these to working pages and associated documents. This approach appeared to result in a good flow of logic as to why each task was necessary and how it related to the overall picture. There was no discernable difference in the quality of the work in the set of groups who adopted each method. Groups who were not adopting an active process of reporting on meetings and assigning/tracking actions were noticeably less effective.

The journal page in general was not used very much and there was a lack of discussion and reflection shown in many wikis. This was raised at the workshops but did not significantly improve.

The intention throughout the course was to play-down direct involvement by the instructor. It was felt that regular advice or recommendations to act in particular way would result in the instructor in-effect managing the project – avoiding one of the main aims. It might also deter students from making contributions. In addition, it was considered unreasonable to show the wiki to the rest of the class in workshops – although the students did choose to show specific content during presentations.

Student feedback

There were five workshop groups and two of them were surveyed to assess their opinions. The students filled-in an anonymous questionnaire of 13 Likert response scale questions and two open-ended questions (prompting what were the best and worst of the wiki experience). Table 1 below shows the arithmetic mean and an indication of the standard deviation for the return of 63 questionnaires. The questionnaire also showed that 47 (75%) of students had never used a wiki before and that 15 students (24%) did not want students from other groups to see their wiki content.

An additional question asked how useful they found the initial pages set up (seeded) in the template. The results showed that the meetings, research and documents links were most valued (a score of 4 out of 5), time planning next (3.6) and the journal least of all (3).

Table 1: Student opinion

	disagree 1	2	3	4	5 agree
We are working well as a team				●	
The wiki encouraged everyone to contribute to the work				●	
The management wiki helped us organise our project work				●	
The wiki helped us meet deadlines			●		
The wiki was easy to use				●	
The wiki helps us collate our knowledge as a group				●	
We like comments put in our wiki by the lecturer				●	
Having access at all times is a considerable advantage					●
We will have a better project because of the wiki			●		
I do not want other groups to see our wiki		●			
I prefer to use the wiki rather than a design file like last semester				●	

The open ended questions produced 23 examples (37% of students) of adverse comments regarding the level of system performance. The server had problems during the first 3 weeks and this created a stressful feeling as students tried to meet an early assignment deadline. In addition there were 9 examples of critical comments (14% of students) referring to the effort required to get through to the wiki – having to log in and go through multiple clicks (approximately 7 clicks to access the first wiki page). There were frequent positive comments praising the offsite 24-hour access to the wiki.

Discussion

The students had undertaken a group project in the first semester – before they had access to wikis and e-portfolios. They were obliged to report in much the same way as for the second semester project – a series of presentations followed by a final report, web pages and submission of their design file. The design file comprised a double ring binder and served as the repository of all the project knowledge – management, research, dialogue covering rationale, meeting notes, trade data, etc. The design file did not particularly work well as a working document – evidenced by regular inspections by the instructor. This was perceived to be mainly because of a lack of a fixed work-place and the nature of modern academic student life where they leave campus after lectures and only one person has the file. The main difference in the second semester project has been their use of a wiki to replace the design file and the web page requirements. The student response has been very promising with a clear indication (from feedback and the questionnaire) that there is a belief that the wiki helps in project planning and organising their work. Comparison with the groups' use of design files from the previous year shows that the groups this year (with the wikis) held and documented significantly more meetings at the half way stage. The wikis at this stage contained significantly more content than the design files at the end of the previous year's semester. In addition their first presentations in this project were significantly better than those at the same stages last year. However there is only a small agreement from the students' response that the wiki will result in a better project than if they had adopted the previous approach and likewise only a small belief that use of the wiki helped them meet deadlines.

The students indicated in their responses that they welcomed comments from the instructor, but were not happy for others to see their work – although several also commented that they would not mind after the project was marked – suggesting competition being the motivation. The wiki facilitated meetings between the instructor and individual groups in particular with discussions regarding group interaction. The instructor intervened on a number of occasions early on in the semester by raising the topic of apparent group difficulties and then discussing situations. This appears to have had a beneficial effect.

Conclusions

1. Students perceive that use of the wiki has significantly enhanced the process and the product of their group project work.
2. The CampusLX implementation within blackboard results in a long process to gain access – this can act as a deterrent to frequent content changes.
3. The wiki improves the sharing of information/knowledge, within the groups
4. The wiki provides documentation of the engineering project development.
5. The wiki provides a good insight into the group dynamics.

References

- Brumley, J., Buckeridge, J. and Grundy, C., 2006. Engineering needs environmental and global thinkers: a contextual analysis of student learning preferences. *Proc. of 17th Annual Conference, Australian Association for Engineering Education, Auckland, New Zealand.*
- Brumley, J. and Horan, E., 1995. Undergraduate Environmental Engineering Education: The RMIT Response. *Proceedings of the National Environmental Engineering Conference, Institution of Engineers Australia.* pp. 181-188.

- Engineers Australia (2004) *Australian engineering competency standards - stage 1 competency standards for professional engineers*, Engineers Australia, Canberra. Accessed at <http://www.engineersaustralia.org.au> August 2007
- EPS Software Corp. (1999) *EPSInternal Wiki Case Study*, EPS Software Corp. 6605 Cypresswood Drive, Suite 300, Spring, TX 77379, USA. Accessed on <http://fox.wikis.com/wc.dll?Wiki~EPSInternalWikiCaseStudy~Wiki> in Aug 2007.
- Fountain, R (2005) *Wiki Pedagogy* Dossiers technopédagogiques, prophetic web site. Accessed at http://www.profetec.org/dossiers/rubrique.php3?id_rubrique=110 in Aug 2007.
- Guzdial, M., Rick, J. & Kehoe, K. (2001) *Beyond Adoption to Invention: Teacher-Created Collaborative Activities in Higher Education* The Journal of the Learning Sciences, Vol. 10, No. 3 (2001), pp. 265-279
- Hadgraft, R. G. (2003) Program Renewal for Sustainable Engineering at RMIT University, *Proceedings of 2003 ASEE annual conference, Nashville, June 2003, paper 1353*.
- Hadgraft, R., Xie, M., Angeles, N. (2004) Civil and Infrastructure Engineering for Sustainability, *Proceedings of 2004 ASEE annual conference, Salt Lake City, June, paper 1608*.
- Kay, J., Maisonneuve, N., Yacef, K., & Reimann, P. (2006) *Wattle Tree: Watt'll it tell us*. Technical Report 582, The University of Sydney, NSW, Australia
- Lamb, B (2004) *Wide Open Spaces: Wikis, Ready or Not*. Educause, September/October 2004, Volume 39, Number 5. Accessed at <http://www.educause.edu/pub/er/erm04/erm0452.asp> in Aug 2007
- Learning Objects, Inc. (2007) *The CampusLX suite*. Accessed at <http://www.learningobjects.com>, in Aug 2007
1801 18th Street NW, Suite 10, Washington, DC 20009 USA
- Reeves, T. C., & Laffey, J. M. (1999). Design, assessment, and evaluation of a problem-based learning environment in undergraduate engineering. *Higher Education Research and Development Journal*, 18(2), 219-232.
- Schneider, D., Paraskevi Synteta, P. & Frété, C. (2002) Community, Content and Collaboration Management Systems in Education: A new chance for socio-constructivist scenarios?. *3rd Congress on Information and Communication Technologies in Education Rhodes, September 26th-29th 2002*.
- Schwartz, L., Clark, S., Cossarin, M. & Rudolph, J. (2004) Educational Wikis: Features and selection criteria, *International Review of Research in Open and Distance Learning*, Volume 5, Number 1. ISSN: 1492-3831
- Trac (2007) Edgewall Software, web site accessed at <http://trac.edgewall.org/> in Aug 2007. Contact Information
Flintvagen 6-216, Umea, NA 90740, USA

Copyright statement

Copyright © 2007 Tom Molyneaux & John Brumley: The authors assign to AaeE and educational non-profit institutions a non-exclusive licence to use this document for personal use and in courses of instruction provided that the article is used in full and this copyright statement is reproduced. The authors also grant a non-exclusive licence to AaeE to publish this document in full on the World Wide Web (prime sites and mirrors) on CD-ROM and in printed form within the AaeE 2007 conference proceedings. Any other usage is prohibited without the express permission of the authors.