

## Successful use of a wiki to facilitate virtual team work in a problem-based learning environment

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***Abstract:** This paper investigates the use of a wiki to support forty-two virtual teams and their development of three team reports for assessment in a core first year course. ENG1101 Engineering Problem Solving 1 uses a problem-based learning paradigm to facilitate the development of effective teamwork, communication and problem solving skills, as well as the acquisition and application of key technical knowledge to real world engineering problems. Our early analysis of student evaluation responses, the monitoring of teams' wiki use and teams' assessment outcomes support our choice of a wiki as a learning platform*

### Introduction

Our wiki (ProbSolv) has been operating for eleven offerings of ENG1101 Engineering Problem Solving 1. It has been particularly important for off-campus students who make up 80% of the cohort and are, as a result of their geographic isolation, required to solve problems collaboratively in virtual teams. Approximately two thirds of students have reported the wiki to be a positive influence on their team work, and facilitators (observing their teams) have witnessed increased interaction and collaboration between team members resulting in improved learning outcomes.

The wiki has had two iterations and its likely suitability was confirmed using Collis and Moonen's four Es (2001) for the first iteration and a combination of Collis and Moonen's four Es, Biggs' principle of constructive alignment (2003) and Reushle's e-learning framework (2006) for the second iteration. These three guided us through a process of examining wiki suitability for the combination of technical, staffing, student, pedagogy and assessment factors particular to ENG1101. Although student evaluation and staff experience support our initial suitability decision, our experience has also demonstrated future improvements for pedagogy and resourcing, and student satisfaction issues that require further consideration.

### Background

#### About the course

ENG1101 has been a core course in all Faculty programs since 2001. It is the foundation course in a strand of four courses which use a problem-based learning methodology. The course aims to engage students in authentic engineering problem solving; learning and applying key technical concepts in physics, mathematics and statistics to real world problems, and developing graduate attributes such as teamwork, communication and problem solving (Brodie, 2007; Brodie & Porter, 2004). It is a unique and innovative course with the majority of students studying at a distance and, as a result, learning within a virtual team context.

## Virtual teams

A virtual team is a team whose members share a common purpose or goal, work interdependently and are geographically isolated from one another. In ENG1101 virtual teams work on specific projects that give them a shared purpose, and members are linked only by communication technologies. Face to face meetings are replaced by a combination of synchronous and asynchronous communication technologies such as email, discussion boards and chat facilities. These collaborative tools offer a variety of unique and powerful information sharing features (Parker & Chao, 2007). Wikis, a major component of the emergent generation of Web 2.0 (social software) technologies (Adie, 2006; as cited by Parker & Chao, 2007), are also of potential value to the successful operation of a virtual team.

The virtual team is not just a phenomenon for study and learning. The skills and knowledge, associated with effective student performance in the virtual environment, were recently recognised as skills for future engineering practice where virtual teams and evolving Web 2.0 technologies are expected to become increasingly common (Jamieson, 2007; National Academy of Engineering 2004; Thoben & Schwesig, 2002)

## Wikis

A wiki is a web site which allows authorised users to edit its pages, thus encouraging collaborative content development (Chao, 2007). Wikis also provide page histories that allow users to monitor the changes made to wiki pages. They are relatively easy to deploy and use and this ease of use makes them particularly useful in an educational setting. Students can concentrate on learning and collaborating rather than developing a new technical competency, and (through page histories) teachers can monitor individual contributions to the collaborative effort.

## Stage 1

### How we came to consider a wiki

It was ENG1101's information literacy activities that first led us to consider the use of a wiki. As students often analyse information needs differently, employ a variety of search strategies to meet the information need and judge information quality differently, or even make deliberate decisions to engage in none of these activities despite their necessity, we needed a means of developing a social environment for our off-campus cohort. As well as influencing knowledge and skill development, social learning also influences perceptions of self-efficacy vital to ongoing information literacy development (Kurbanoglu, 2003). This self-efficacy element also needed to be properly addressed.

Prior to the wiki's introduction, our on-campus students attended face-to-face sessions in the Library. In these sessions students pursued social (J. W. Collis & O'Brien, 2003 p 38) and active learning (J. W. Collis & O'Brien, 2003 p5 ) activities centred around finding and using information relevant to the course. The learning activities were built on "information needs scenarios" that drew on the course's graduate attribute demands such as team work, communication and report writing. Students chose to work in small groups, pairs or individually and, in these configurations, analysed the information needs falling from their scenario, searched for the information and then reported back to the entire group. In the report-backs, students explained and compared their analyses, search strategies, rationale for those strategies and search results. As entire class, then, individuals were exposed to alternative ways of thinking and acting in their information seeking and utilisation activities. They could see themselves succeed and they could see their peers succeed; two of the most important sources for the development of perceptions of self-efficacy (Kurbanoglu, 2003).

Our off-campus students had, until the wiki's introduction, been provided with an online guide (consisting of static web pages) and were expected to work through the guide in isolation. This clearly put off-campus students at an unacceptable disadvantage. Those who chose to complete the guide had no opportunity to observe how others analysed the same information need and set about meeting that need. Even more significant, we suspected that (unsupported by librarian and course examiner intervention) few students actually used the guide to develop their information literacy skills. At first glance a wiki seemed the perfect platform for creating the social learning environment suited to information literacy development. We felt that it might be used to create an active learning platform

that allowed students to interact with each other as they developed their information literacy knowledge and skills in a team environment.

### **Stage 1: testing the model**

We could not, however, implement a new learning tool without objectively considering its suitability. We used Collis and Moonen's (2001) four Es to evaluate the suitability of a wiki to our circumstances. Collis and Moonen identified four factors particularly important to online tool choice - environment, educational effectiveness, ease of use and engagement.

Included in the environment criterion are two fundamental issues: the institution's ability to support implementation, and staff's ability to actually use the tool in question (B. Collis & Moonen, 2001 p53). If USQ (generally) and the Library and Faculty (specifically) could not support the tool, student learning could be expected to suffer seriously. In our case the Library and Faculty (specifically) and the University (more generally) demonstrated a strong interest in Web 2.0 applications. This USQ and Faculty interest in, and Library commitment to, appropriate wiki implementation stemmed from an organizational culture influenced by a majority off-campus cohort that requires equitable education provision. In fact, USQ has a long institutional history of distance learning innovations.

We also possessed the makings of a strong staff team (Course Examiner, Faculty Librarian and Electronic Services Officer). The Course Examiner and Faculty Librarian had developed a productive and collegial relationship prior to this point and both were keen to explore new technologies that reduce student isolation and support active learning from a distance. The Electronic Services Officer had a reputation for client-focused and collaborative work so we felt confident that we three could work, as a genuine team, through the various technological and pedagogical issues likely to arise.

And so, a wiki-based information literacy activity was created. Each team was assigned a wiki page containing a scenario and an activity which guided team members through the information needs analysis, choice of search terms and development of search strategies. Analysis, search term choice and search strategy development were scaffolded with a matrix to guide question analysis and search strategy development and points for reflection on search results.

Each team was also assigned a pair team. Teams completed their own work and then reflected on their pair team's work in a Comments section (a wiki feature). Each team worked with a different scenario from their pair team so that every team worked through two information needs scenarios and had the opportunity to observe alternative ways of analysing and searching successfully.

The Electronic Services Officer developed a wiki architecture that divided each page into separate, secure areas so that teams could only write/edit in appropriate areas and pair teams could only comment in a special comments field. At the end of the activity, teams' wiki pages provided an insight into how search strategies were developed, how search results were evaluated and the different ways students thought through and acted in their information seeking activities.

Although the information literacy activity was neither assessable nor compulsory, a review of students' work and course evaluation responses revealed that half of the students completed the activity and most of these found the wiki relatively easy to use even though a WYSIWYG function was not employed at that stage. Several students were even sufficiently intrigued by the notion of the wiki as a communication platform, that they explored wiki use in the engineering firms where they worked. Some teams also set up their own unsupported wiki pages in the Student Sandpit area of the wiki. These experiences confirmed our evaluation of a wiki platform as a tool for promoting social learning and scaffolded information literacy learning (educational effectiveness and engagement) and our expectation that it would be relatively easy to use.

As it was important that mischievous students could not edit other teams' pages, security specifications were one of the main drivers for TWiki as our product of choice. We surveyed a variety of open source wiki platforms for easy customability, local hosting, access control lists and commenting by peers. We found two products that met our needs and chose TWiki after assessing how each product matched with our staff skill set. TWiki was the product that met our pedagogical, systems and staff resource constraints.

## Stage 2: re-defining the model

The level of student acceptance in Stage 1 led us to consider extending the wiki's application to a broader course environment; to facilitate the team collaboration necessary to produce all three team based assessment items. To ensure the wiki's continued relevance and student use (educational effectiveness and engagement); we "tested" our proposed wiki use against Reushle's e-learning principles (2006) and Biggs' constructive alignment (2003). We were particularly concerned to ensure a strong alignment between the wiki platform and the course's communication, teamwork and report writing objectives and the constructivist problem solving pedagogy of PBL, as well as the course-long feature of teamwork which placed extra emphasis on platform suitability and reliability. We also wanted to ensure that fundamental e-learning principles such as reflection, discourse and modelling by both educators and learners (Reushle, 2006) would all be promoted.

### Facilitator experience

Prior to using the wiki, teams allocated the 'collation or writing' of the final report to a team member. Individuals completed assigned tasks and then forwarded them to the designated report writer for inclusion. As a consequence, submitted reports were not always the result of a collaborative effort even though producing a report collaboratively is a significant objective of the course.

With the wiki in place, advice from facilitators and the analysis of assessment criteria indicated that more team members from more teams provided input to the report as a whole and critiqued sections or tasks outside their initial task allocation. Facilitators did, however, note that teams often had difficulties, or showed reluctance, to take the information and solutions that they'd provided in the wiki pages and move them to a formal report style Word document. Despite this, facilitator response to the wiki was positive and a wiki is now being used in the following course of the Problem Solving strand, Engineering Problem Solving 2.

### Student experience

The on-campus and off-campus student experience was evaluated with an online survey conducted at the end of Semester 1 2008. 63.4% of students completed the survey.

64% of students responded that the wiki helped them communicate and collaborate with team mates, 7% expressed no opinion, 24% felt that the wiki didn't help them communicate and collaborate and 5% indicated that they did not use the wiki. When asked if the wiki made the team's work easier to manage, 53% responded that it did, 17% had no opinion, 25% disagreed and 5% did not use the wiki. Over the entire semester, 1094 pages were created by 58 teams and there was a total of 14988 edits.

These raw figures require further analysis for factors such as:

- Differences in wiki use and value for on-campus students who can meet face-to-face
- Correlation of wiki dissatisfaction with problems meeting certain learning objectives (eg. team work, communication)
- Clash of expectations for those students (particularly off-campus students) who expected to study autonomously and restrict their study activities to weekends
- Clash of expectations for students who expected traditional didactic teaching methods
- Preferences for other means of collaboration
- Program undertaken.

As teams used the wiki to work collaboratively on assessment pieces, students were very conscious of page security. The wiki architecture ensured that each team's page set was visible to and editable by only its members, facilitator, course examiner, faculty librarian and the wiki administrator (the Electronic Services Officer). We did find that many students resisted following a simple instruction for creating new team pages and created many "orphan" pages that the wiki administrator had to re-link to the other team pages. We suspect that "losing" orphan pages may have affected wiki satisfaction for students who consistently refused to follow the page creation instructions provided.

On the wiki home page, we provided a brief list of things for students to consider for keeping the wiki pages organised and easy to read by all team members. When asked, in the evaluation survey, whether

the wiki was easy to use once they "got the hang of it", 67% students indicated that they found it so, 8% expressed no opinion, 20% found that it was not easy to use and 5% did not use it.

We also provided simple instructions for the wiki features most likely to be used (eg. creating a new page that is linked to the existing page). As expected, many students neglected to read the instructions despite recommendation in one of the examiner's early weekly 'to-do' lists and regular urgings from the librarian. As web pages are often scanned rather than read, we used a wiki discussion forum on the learning management system to facilitate discussion on wiki use issues. Having this additional opportunity to seek and provide support improved the wiki's performance on ease of use and student engagement criteria.

We analysed the questions and comments posted on the forum and found them to be dominated by two issues: questions about registration and page access (largely related to students not reading instructions) and complaints about sever downtime. Assignment 1 work was seriously disrupted when we had to replace the server prior to the mid-semester break. We had planned to replace it during the break and after Assignment 1 submission (to minimize disruption) but issues in the University's Information Technology Division brought the change forward. Pleasingly, although we suffered another (though short) period of downtime later in the semester, rather than a flood of discussion forum complaints, only a few postings appeared. Each of these posts alerted us to the problem and expressed confidence that it would be quickly resolved.

## **Improvements we would like to pursue**

Although the wiki has worked well so far, we do have five major improvements to pursue. First, we would like to develop an automatic registration system for the students. We find that even "digital natives" (Prensky, 2001) can feel hesitant about the registration process. This hesitation appears to be related to four main factors: minimal or no experience with wikis except Wikipedia, distraction of the unexpected format of a problem-based learning course, general anxiety related to being enrolled in the first course of the program and anxiety surrounding computer use which is most particularly experienced by the Associate Degree students.

Second, automation of the process of assigning students to team pages. The faculty librarian must assign each student to their team page set. This is an extremely time consuming process with enrolment numbers ranging from approximately 250 to 500 students per semester. Assigning students to teams is an essential activity as it ensures viewing and editing security for each team. The time intensive nature of this process is further exacerbated as it occurs at the beginning of semester, an extremely busy time for the Library as a whole and when the faculty librarian takes on extra responsibilities outside normal duties.

Third, we would like to move away from TWiki, as our wiki platform, to the Learning Management System (LMS) - Moodle. At the moment Moodle is not able to provide the same level of functionality as the Library's TWiki wiki but we will monitor the development of Moodle's wiki. Integration with the LMS will facilitate improved technical support processes and using a common platform for all learning tools would be a major improvement in "learning centredness" (Anderson, 2004).

Fourth, we would like to add a function to integrate diagrams and graphs into wiki pages. It is currently possible for content generated outside the system, such as spreadsheets and graphics, to be attached to a wiki page, but students have requested an option that allows them to work collaboratively on the raw data and lets the wiki take care of its rendering. There are TWiki plugins reputed to make this possible, and the team has also discussed the prospect of implementing its own in-house solution. Time constraints have prevented us from pursuing either option at this stage.

Finally, as people learning to operate in virtual teams and use Web 2.0 tools, students sometimes used the wiki at times when it was not the most appropriate option. Inappropriate tool choice made it harder for facilitators to monitor report progress and redirect team thinking when necessary. Facilitators found it much easier to follow progress when teams were restricted to asynchronous team discussion forums in the LMS. For the time being, facilitators will adapt their facilitation methods to the situation. For next year's offers, we will develop a means of supporting informed choice of Web 2.0

tools. This seems an ideal resolution as, despite occasional inappropriate tool choice, assessment outcomes have been improved with wiki use.

## Conclusions

Incorporating Web 2.0 tools into a course requires the consideration of a number of factors. These are not complex factors but they must be fully considered to ensure that off-campus students (particularly) can focus on learning and collaboration rather than acquiring technical competencies associated with the tool. We used Collis and Moonen's four Es (2001), Reushle's e-learning principles (2006) and Bigg's constructive alignment (2003) in our attempts to ensure a learner-centred and learning-centred (Anderson 2004) wiki platform that supported virtual teams and their collaborative assessment work that occurred across the course of the entire semester, and supported the examiner's other carefully constructed and aligned course elements. A wiki, we discovered "in the hands of a healthy community works. A wiki in the hands of an indifferent community fails" (Shirky, 2003 as cited by; Tsinakos, 2006 p 2-7). This maxim applies, not only to student communities, but to the staff team which develops, maintains and monitors wiki use in an evolving educational environment.

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