

Promoting collaborative learning in engineering management education through the use of wikis

Fiona Saunders fiona.saunders@manchester.ac.uk, Mark Jasper mark.jasper@manchester.ac.uk, Peter Whitton p.d.whitton@salford.ac.uk

Authors 1 and 2 are from The University of Manchester, United Kingdom. Author 3 is from The University of Salford, United Kingdom

Abstract:

One of the key demands of industry is that today's engineering students acquire the necessary collaborative skills to be able to work effectively in multi-disciplinary and multi-national teams. Universities and engineering accreditation bodies have responded to this by requiring that engineers complete elements of group work in their undergraduate and postgraduate studies. However in an environment of ever increasing student numbers teaching collaborative skills through group work has become both a pedagogic and logistical challenge.

This paper argues that the use of web 2.0 collaborative tools such as wikis may offer academic staff a safe passage through this challenge. It describes the design and delivery of a collaborative wiki-based coursework project on a module in the Masters in Management of Projects at The University of Manchester. The module is delivered on campus to 250 postgraduate students, introducing them to the financing, structuring and management of infrastructure projects. The wiki-based coursework project was delivered using the Confluence wiki tool running within the university's Virtual Learning Environment (VLE). Students were required to organise themselves into groups, and to formulate and investigate their own research topic based on a real life infrastructure project.

The outcomes of the project included an enhanced student learning experience, improved collaborative working and cohort cohesion on a large postgraduate programme and generated new course content for future student cohorts. In addition the project served as a tested pilot study of the use of wikis prior to roll-out across other programmes at The University of Manchester.

Background

One of the key skills required of today's engineering students is that of collaboration. The engineering industry demands that new graduates possess the interpersonal skills to quickly become effective team members, collaborating to deliver increasingly complex engineering projects. The UK engineering specification reflects this, requiring accredited engineering degree programmes to teach "effective interpersonal skills" (EngineeringCouncil,2004,p11). Group working is viewed as the primary mechanism to teach these interpersonal skills with undergraduate and postgraduate engineering students expected to complete a range of group projects, from first year poster presentations, to 4th year semester-long design projects.

The challenge facing Higher Education Institutions across the world is how to teach these skills against a backdrop of ever increasing student numbers. Designing and implementing group based learning activities that teach collaboration skills is relatively straightforward when cohorts are 25 to 30

in size, but how do academic staff meet the logistical challenge of delivering effective group work to cohorts comprising 250 students?

This paper argues that the use of web 2.0 collaborative tools such as wikis can offer academic staff a safe passage through this challenge. The particular context of this study is the delivery of project management education to cohorts of upwards of 250 predominately engineering students. It describes the design and delivery of a collaborative wiki-based coursework project on a module of the MSc in Management of Projects at The University of Manchester. The semester-long module is delivered face to face to 250 postgraduate students from over 30 countries and introduces students to the financing of infrastructure projects, such as roads, bridges, and power plants. For their assessed coursework, students were required to organise themselves into groups, and to formulate and investigate their own research topics based on a real life infrastructure project. The coursework output was a wiki, set up and delivered using the Confluence wiki tool running within the university's standard Virtual Learning Environment (VLE) Blackboard.

This paper describes the benefits and pitfalls, both pedagogic and technical, of the wiki-based group project. The effectiveness of using the wiki in enhancing student learning, promoting collaborative working and improving cohort cohesion was also measured using a quantitative survey of the 2009 cohort.

Literature review

Wikis: Benefits, Applications and Limitations

The term wiki is inspired by the Hawaiian expression “wiki wiki” meaning quick (McKiernan, 2005). Wikis are collaborative web sites that allow multiple users to quickly add, edit and restructure content related to a particular topic. The best known example of a wiki is Wikipedia, whose scope as an online editable encyclopedia dwarfs that of its pre-web rival Encyclopedia Britannica. Berkman (2004) provides the following technically comprehensive definition of a wiki

“a wiki is a collection of related HTML pages, typically residing on a server, created by wiki software. Wiki software permits and is designed to enable any visitor to edit the existing wiki documents without any special access authorisation. No programming or technical capabilities to make edits or add new wiki pages are required; edits can be input right on the document and they take effect immediately. As such a wiki embodies what is called an open editing philosophy” (Berkman, 2004, p1)

Wikis may be viewable and editable by any internet user, or access may be restricted to registered members only. Evans (2006) describes wikis as a tool that allows groups of students to collaborate in the completion of a shared task, harnessing the group's creative endeavour and documenting their progress as they proceed through the task. The simplicity of set up of a wiki combined with its powerful web enabled collaboration potential has driven its adoption in both the corporate and academic world (Cronin, 2009). Typical uses of wikis include the collaborative writing of documents, research papers and text books, or as a central repository for project or other corporate information (Duffy 2006), (Ferris & Wilder 2006), (Hammond 2007) and (Mason & Rennie 2008).

Although much research has highlighted the potential benefits of well supported wiki-based activities to the learner, some researchers have indicated possible problems with their use in an educational setting. For example there is an argument that the ease of editing of wikis and the democratic way in which content is uploaded may result in the wiki consisting of a lot of low level content; the triumph of quantity over quality (Mason & Rennie 2008). Wheeler, Yeomans et al (2008) argue that students may be tempted to cut and paste information wholesale from the internet, rather than analysing, evaluating and refining it. Related to this, the proliferation of content on a wiki requires careful structuring and arranging to remain user friendly and navigable.

Various studies have also shown students and faculty alike grappling with issues of ownership of posted material, with students becoming protective of their own contributions and sensitive to peers amending or even deleting their contributions (Da Lio, 2005) and (Wheeler, Yeomans et al., 2008). Lastly, whilst wikis are in theory simple to build, training is still necessary for both faculty and students in order to optimise the finished product and promote effective learning (Engstrom & Jewett 2005) and (Cronin, 2009).

Setting the wiki in its pedagogic context

Constructivist learning theory (Bruner 1960; Jonassen, Peck et al. 1999) and (Biggs, 1999) is de rigueur in Higher Education today (Houghton 2004). In constructivism knowledge is constructed by the learner rather than given by the educator. Understanding is achieved via an iterative process of creating, hypothesising and interpreting new knowledge which is scaffolded onto the students' prior knowledge base (Kuiper & Volman 2008). Students are no longer passive recipients of knowledge but are active in constructing and making sense of knowledge (Sfard, 1998). Wikis enable this shared construction and structuring of knowledge. *"Users are encouraged to contribute and interact with other users rather than be passive recipients of static information."* (Mason & Rennie 2008, p66). Wikis provide a blank canvas upon which groups of students can assemble and structure knowledge and learning. Few boundaries are set by the teacher other than to set assessment criteria and act as facilitators of the learning process.

Miers summarises constructivist learning as being active, reflective, authentic, challenging and grounded in the real world. In addition learning is to be co-operative, collaborative and conversational. (Miers, 2004). Collaborative learning is based on notion that learning is a naturally social act. It is through talking to one another that learning occurs (Gerlach, 1994). In order for collaborative learning to occur students need to be allowed to discuss problems with each other, to share thoughts and construct frameworks of ideas and concepts. This interaction needs to be easy, frequent and, if it is to be assessed, clearly documented. Therein lies the core strength of the wiki. Its inherent flexibility, the fact that amendments can be clearly traced back to an individual user, and the positive interdependence of students working together to achieve a common goal all act as powerful stimuli to increased collaborative learning (Johnson, Johnson et al., 2007), (Bruns & Humphreys, 2005), (Bold, 2006) and (Nicol, Littlejohn et al., 2005).

Previous studies on the use of wikis in Higher Education

The volume of literature on the use of wikis in Higher Education worldwide has grown rapidly since the first papers in the early 2000s. Previous studies can be categorised into three broad areas

- 1) studies concerned with the theoretical underpinning of wikis within existing learning theory (Mindel & Verma, 2006), (Ferris & Wilder, 2006), (Parker & Chao 2007), (Moskaliuk, Kimmerle et al., 2009), (Ruth & Houghton 2009).
- 2) case studies describing the implementation of wikis and
- 3) studies addressing particular issues associated with the adoption of wikis, for example how to assess individual contribution to a wiki in an equitable manner (Trentin, 2008).

Under 2) published case studies exist in subjects as diverse as primary education training, language development, information management, software engineering and marketing education. Wikis have been implemented on campus based and distance learning programmes (Elgort, Smith et al., 2008). Wikis have been used variously in undergraduate and postgraduate education and across a wide geographical spread of countries. Outputs have included online marketing websites and text books (Cronin, 2009), (Workman, 2008), knowledge repositories and learning journals for trainee teachers (Matthew, Felgevi et al., 2009) and (Wheeler, 2008) knowledge management and information management wikis (Kai Wah Chu, 2008), (Cole, 2009) and (Elgort, Smith et al., 2008), and to support the development of software development skills (Reid & Wilson, 2007).

The majority of these studies reported positively on the use of wikis to enhance student learning. Although none of the case studies attempted to verify this by demonstrating improved student grades, surveys of the cohorts provided evidence that students enjoyed working with wikis, and that through them their learning was enhanced (Harris & Zeng, 2008), (Elgort, Smith et al., 2008), (Workman, 2008). (Matthew, Felgevi et al., 2009) and (Kai Wah Chu, 2008) reported that wikis did improve collaboration by students, increasing their appreciation of classmates' knowledge, encouraging learning from peers and providing students with a *"voice in a community of practice"* (Wheeler, 2008, p990). Wikis were also found to improve student engagement and motivation (Elgort, Smith et al., 2008), (Cronin, 2009). The lone voice of caution was provided by Cole (2009) who counsels educational users of wikis to pay close attention to integrating the wiki within the course design and its intended learning outcomes as failure to do this resulted in poor student engagement with the wiki.

Other challenges associated with wikis were the requirement to provide a well structured process for the creation, development and management of the wiki (Cronin, 2009), accompanied by effective training on the technology, such as tutorials, sandpit areas and how to guides etc (Cronin, 2009),

(Wheeler, 2008) and (Kai Wah Chu, 2008). The majority of the negative comments surrounded technical problems with wikis, e.g. lack of user friendliness, limited editing capability, and accidental deletions of material. This derives in part from the students' lack of experience with wikis and in part from the rudimentary nature of many available wikis. Teaching staff do need to be prepared to step in with technical support if students are struggling with the technology (Cronin, 2009), (Workman, 2008).

The common factor in all of these empirical studies is that the average student cohort size is from 17 to 70. There are no peer reviewed studies of the use of a wikis to enhance collaborative learning within much larger (250 plus) cohorts. Implementing collaborative learning in such large cohorts is a sizeable logistic challenge and any minor problems concerning the assessment process are magnified by the large cohort size.

In direct response to these challenges, this paper describes the implementation of a wiki-based group coursework project within a large cohort project management programme and evaluates the extent to which the use of wikis enhanced student learning, promoted collaborative working and improved cohort cohesion.

Methodology

This section describes the collaborative wiki-based project. It introduces the course in which it was implemented, and describes the design and set up of the wiki-based assessment, both in terms of technology and assessment task.

The course and its pedagogy:

The project finance module was delivered face to face to 250 postgraduate students over a 12 week period in semester 1 of 2009. The student cohort is an international one with 90% of students coming from overseas. The majority of students are full-time postgraduate students with an undergraduate engineering degree, aged between 22 and 25 years, with a small number of part-time mature students. In addition to face to face lectures the module makes extensive use of The University of Manchester VLE, Blackboard, with students expected to download lecture notes, interact with teaching staff via the discussion boards and use the VLE to access supplementary exercises. Prior to this study the coursework assessment had involved an individual essay on a real-life project finance case selected by the lecturer. The perceived benefits of moving to a wiki-based group assessment included the enhancement of student learning by adopting collaborative working and as a result, potentially improving cohort cohesion on this large international taught postgraduate programme. It was also hoped that the wikis would serve as new course content for future cohorts.

The wiki-based assessment:

The wiki-based group coursework was set up and delivered using the Confluence wiki tool (<http://www.atlassian.com/software/confluence/>) running within the university's institutional VLE Blackboard. Confluence was chosen by the authors because of its integration with Blackboard, which meant that the wiki was visible within a frame within the VLE. The Confluence wiki is connected to Blackboard via a PowerLink, which enables it to function like any of the VLE's own tools. Having a wiki contained within Blackboard meant that student registrations and group sign-up could be administered through the students' existing university usernames and passwords. Having the wiki integrated into the VLE provided a number of additional benefits to the student. The PowerLink meant that groups created within the VLE would automatically be set up in the wiki space too. Each wiki section could also be selectively released and hidden on particular dates and only made available to those students who had signed up to a group. Sitting within the VLE the wiki became another tool within the student's learning environment, albeit an important one that would be used as part of the assessment.

One drawback of using The University of Manchester Confluence PowerLink was that it had not been used with a large cohort before. It had been systems-tested over the previous few months and used by small groups across the University, but for a project this size the authors were essentially pioneers.

Preparation and wiki set up

The authors decided early on that it would be more convenient to have one wiki for all groups. Each group would see the home page of the wiki and from there have access to its own private page(s). This method was preferable to creating and managing over 50 separate wikis. The authors created a home page and then a single page for each group within the wiki. Viewing and editing these pages was restricted to one particular group plus the lecturer and learning technologist. Each group could add additional pages to their section of the wiki and their access rights would be replicated.

Acknowledging that students' prior experience of wikis would be very varied, the authors planned a phased approach to wiki familiarisation. A sandpit wiki was created where the students could practise using the wiki's content creation and editing tools. The sandpit wiki was available for three weeks, after which it was removed from view and the course work wiki became available.

Students accessed the wiki via their course materials folder within the VLE (see Figure 1 below). Within the same folder they also had access to a study area containing learning modules which were time released alongside each week's class. Each week's learning module integrated course materials with resources on how to use the wiki and discussion forums. Instructions on using the wiki were built up over a four week period from an initial introduction and orientation to notes on how to edit, structure, link and add images. The week four learning module coincided with the removal of the sandpit wiki and the introduction of the coursework wiki.

The screenshot shows the Blackboard VLE interface for the 'Project Finance Coursework' wiki. The page is titled 'Project Finance Coursework' and includes a navigation menu on the left with options like 'Course Tools', 'Instructor Tools', and 'Manage Course'. The main content area features a 'Welcome' message, a 'Task' section with a list of seven requirements, and a 'Create your wiki' section with instructions on how to create a group page. The 'Task' section lists the following requirements:

1. Collaborate as a group to search for and select a Project Finance case study (for example M6 toll road, Channel Tunnel etc)
2. Work together as a group to design and produce a wiki that communicates the following:
 1. Introduces the project with key facts and figures
 2. Describes and evaluates the structure of the project (including key parties, contractual structure etc)
 3. Critiques the financing of the project (including parties involved and instruments used)
 4. Assesses the operation of the project including the drawing up of a hypothetical cumulative cashflow analysis
 5. Links key aspects of the project with the relevant theory underpinning project finance
 6. Analyses the project challenges and how they were overcome
 7. Shows evidence of the contribution of all group members to the adding, editing and structuring of the wiki (including minuted group meetings)

The 'Create your wiki' section includes the following instructions:

Click on the child page for your group below to begin your first wiki page.
Nb. If you add a page to this home page everyone on the course will see it. Please use your group page to keep your coursework private.

Below the instructions, there is a list of 12 group pages, each with a small icon and a label like 'Group 01 - Drax Power Station Acquisition'.

Figure 1: Screen shot of wiki home page within the Blackboard

In addition to the 'how to' guides contained within the learning modules, students could use the discussion forums to get support and advice. A topic was created with the aim of providing students with a space where they could ask each other questions on any aspect of using Blackboard. Ultimately, this technical forum became a key channel of communication between students with particular wiki issues and the learning technologist. In response to the volume of comments posted on the technical forum, 1 hour wiki tutorials were held for students in weeks five and six of the course to respond to particular wiki problems.

The assessment task:

Students were required to self select into groups of five for the wiki project, with their task to develop a wiki on a real project finance infrastructure project. Students selected an appropriate project to study and then created both the structure and content of the wiki. A framework for the wiki was consciously not provided as it was felt this might limit the students' imaginations in constructing the wiki. In total the cohort produced 50 wiki sections, covering an extensive range of infrastructure projects including iconic projects such as The Channel Tunnel, Delhi Metro, and Athens International Airport. Eight of the wikis are of sufficiently high quality to act as case study examples to future student cohorts, adding to the richness of the module material. These exemplar wikis will be added to the course Blackboard site. The spread of marks awarded for the wikis was broad. Contrary to Wheeler, Yeomans et al. (2008) the cutting and pasting of material from the internet was not prevalent except in the minority of

cases. Rather most students were able to filter and differentiate information to build up a rich case study analysis.

Key findings: Benefits and Issues

The 2009 cohort of 250 were surveyed using anonymous questionnaires circulated and completed during the well attended revision lecture. The questionnaire was designed by the authors and piloted on the lecturer's postgraduate tutor group. 185 questionnaires were returned, giving a response rate of 74%. An excerpt from the questionnaire is shown in Figure 2 below.

FOR EACH STATEMENT BELOW PLEASE TICK THE APPROPRIATE BOX TO SHOW HOW MUCH YOU AGREE OR DISAGREE WITH EACH STATEMENT.

1) Understanding of project finance
 The development of a group based wiki for the project finance coursework...

Helped me add new knowledge and understanding of project finance

Strongly agree Agree No difference Disagree Strongly disagree

2) Opportunities for collaboration
 The development of a group based wiki for the project finance coursework...

A... Helped me build relationships with other students

Strongly agree Agree No difference Disagree Strongly disagree

B... Provided increased opportunities for collaboration with other students

Strongly agree Agree No difference Disagree Strongly disagree

3) Control of learning
 The development of a group based wiki for the project finance coursework...

...Increased my control over how I learnt about project finance

Strongly agree Agree No difference Disagree Strongly disagree

4) Benefits of the wiki

PLEASE RANK THE FOLLOWING FACTORS 1 TO 3 IN TERMS OF USEFULNESS OF THE COURSEWORK WIKI. GIVE EACH FACTOR ONE RANK, WITH 1 BEING THE HIGHEST RANK AND 3 BEING THE LOWEST RANK.

a) The wiki increased my knowledge and understanding of project finance

b) The wiki increased the opportunities for collaboration with other students

c) The wiki increased my control over how I learnt

Figure 2: Excerpt from Cohort Questionnaire 2009

In addition to the closed questions in Figure 2, students were asked about the benefits and drawbacks of the wiki coursework and what could have been done to better prepare students for the wiki coursework. These open questions were analysed using content analysis to search for recurring themes.

The findings of the questionnaire painted a rich picture of the students' experience with the wiki project, both from a pedagogic and a technological standpoint. Figure 3 illustrates the response to questions 1-3 of the survey. Both the raw numbers and the percentage of the cohort are reported in each instance. It shows that the majority of students benefitted from the wiki coursework in terms of

increased knowledge and understanding of the subject matter (68% of survey respondents), increased collaborative working (66%) and relationship building with other students (72%). A smaller majority of students (54%) also found that the wiki allowed them increased control over their learning.

The development of a group based wiki for the project finance coursework...

Question	Strongly Agree	Agree	No difference	Disagree	Strongly Disagree
	N and (%)	N and (%)	N and (%)	N and (%)	N and (%)
1) Helped me add new knowledge and understanding of project finance	18 (10%)	109 (59%)	46 (24%)	9 (5%)	4 (2%)
2A) Helped me build relationships with other students	48 (26%)	86 (46%)	38 (21%)	12 (6%)	1 (1%)
2B) Provided increased opportunities for collaboration with other students	37 (20%)	87 (47%)	42 (23%)	14 (8%)	5 (3%)
3) Increased my control over how I learnt about project finance	10 (5%)	90 (49%)	60 (32%)	20 (11%)	5 (3%)

Figure 3: Percentage of respondent's answers to Questions 1-3 of the questionnaire

One student described the wiki as:

"the perfect way to work on a case study in a team, and improve knowledge of project finance".

Many other positive comments about the wiki were received with students enjoying the opportunity to put the lecture material into practice, and benefiting from the collaborative potential of the wiki building process.

In contrast it is a concern to the authors that there is a proportion of the cohort (approximately 10%) who did not appear to engage in the task, either in terms of its learning or collaboration potential. It is broadly the same individuals who disagreed or strongly disagreed with each of the statements made in questions 1-3. Investigating the comments made by these dissatisfied students it seems as if criticisms of the technology and difficulties in using the wiki distracted them from the core subject matter of project finance. As a consequence these students were inhibited from collaborating, felt isolated from their fellow students and not in control of their learning. Comments made by some of these students included:

"technology too complex, which affected the mark awarded"

"by the time we understood how to use the wiki, it was a bit late to start the project"

In ranking the benefits of the wiki-based coursework (Question 4 of the questionnaire) 38% of students ranked the opportunity to collaborate with other students as the most useful aspect of the wiki, 30% of students ranked increased knowledge and understanding of project finance as the most useful feature, with only 16% of respondents ranking the ability to control one's own learning as the most useful feature of the wiki. These findings support the experience of previous studies, in particular (Kai Wah Chu, 2008) and (Matthew, Felgevi et al., 2009).

Benefits of the wiki

The student responses to the open questions provided a degree of explanation for the quantitative responses in questions 1-4. Students were vocal and articulate in their assessment of the wiki coursework and in proffering ideas for improvement. Figure 4 shows the breakdown of the answers to Question 5 of the questionnaire "Can you think of any other benefits from using the coursework wiki?"

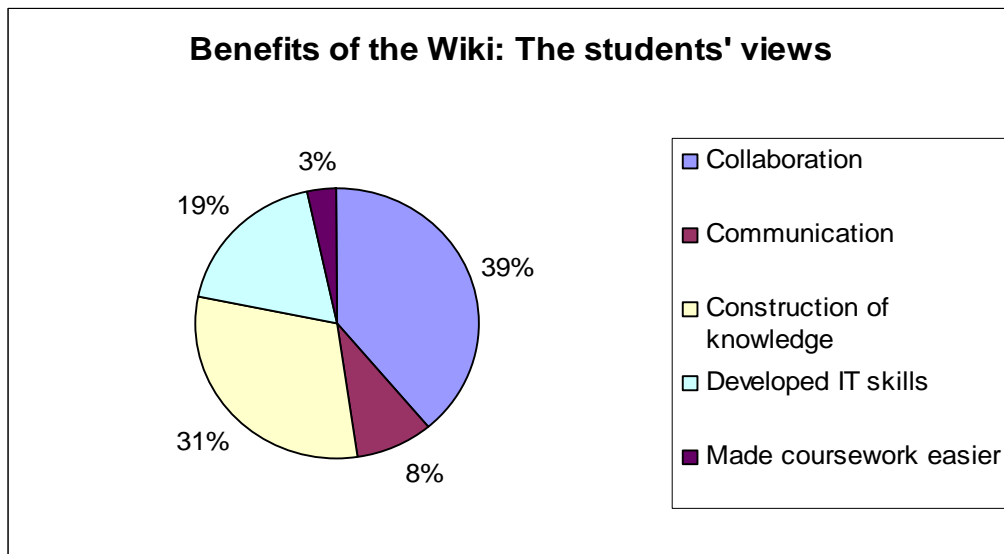


Figure 4: Percentage responses to Question 5 of the questionnaire

Figure 4 supports the earlier findings of Question 4; that the two most important benefits of the wiki coursework were in increasing collaboration amongst students and in enabling the construction of knowledge. For the authors this is a key finding of the research, as it was the principal reason behind implementing a group based wiki collaborative project. One student commented that

“Collaboration was a major part of the wiki project and certainly assisted my teamwork and communication skills. It was an innovative way to complete a coursework and significantly easier to organise & more fun than an essay question”

Another stated that the wiki provided

“Better structure to organise the knowledge ; Brings the theory to practice ; Team work”

A number of respondents (19%) also learnt new IT skills during the project; an important by product of the project in today’s web enabled world. Comments such as

“the Wiki let me find a new instrument to exchange information and vision sharing. Probably, I will use this instrument in the coming years of my working”

reassured the authors that their assessment process was real-life, relevant and useful for the students.

Disadvantages of the wiki

The responses to Question 6 “What were the drawbacks from using the coursework wiki” are illustrated in Figure 5 below.

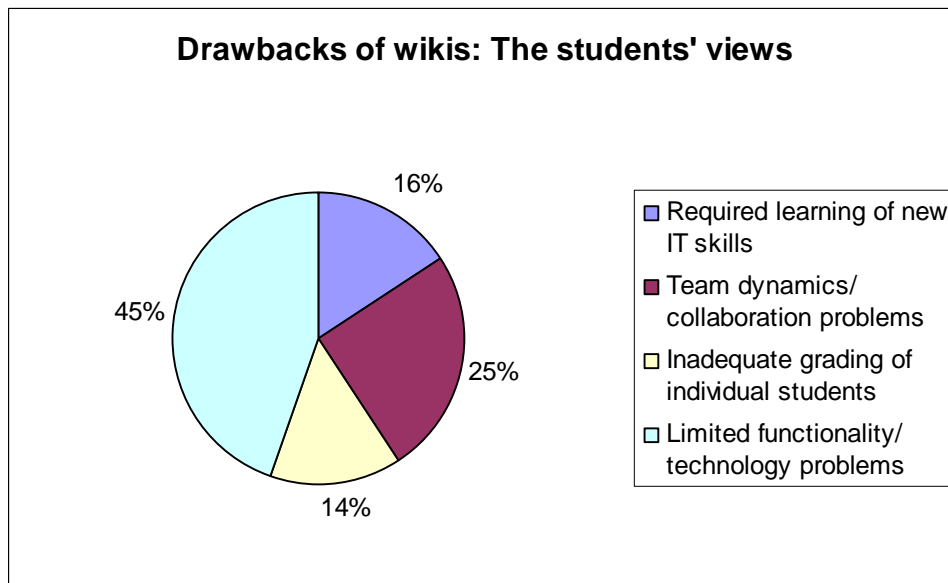


Figure 5: Percentage responses to Question 6 of the questionnaire

The most serious concern expressed by students relates to the technology underpinning the wiki and the VLE (45% of responses). The Confluence wiki was not perceived as user friendly, and some students had considerable difficulty adding, rearranging and deleting content. Similar problems have been widely reported in the literature, notably by (Cronin, 2009) and (Workman, 2008). Technology issues were a distraction from the wiki coursework and occupied much of the authors' time during the semester. The authors' initial view was that this was due to the authors being pioneers in the use of wikis at the University, and that the problems were exacerbated by the set up of the Confluence wiki within the VLE, for example, the permission to delete pages was denied to all students. There was also an inconsistent connection with the PowerLink which led to a small number of students being deregistered from the module. The result of this was a loss in confidence in the wiki by some students, as articulated by the following student response

"There were unnecessary complexities involved in the wiki. This affected our performance and teachers evaluation technique also. We lost many marks due to technical glitch in Wiki. This was not justified to me".

A possible solution to this would be to use a standalone wiki, distinct from the VLE in next year's cohort. However sentiment amongst other experienced wiki users both inside and outside the University is that wiki software is often not user friendly, irrespective of the tool used. A more pragmatic approach might therefore be to use Google Docs or MS Word on SharePoint next time the course is run, maintaining the collaboration potential of the project, but reducing the amount of time students have to devote to learning a new technology.

Aside from technology issues, many student comments related to team dynamics, and the inequitable contribution of some team members to the task. This is a constant theme for academic staff setting group coursework, irrespective of the format of the coursework. Related to this was the issue of grading individual contributions to the wiki, as articulated by this student

"Members contributions were not assessed; all group members got the same mark, however some of them did not work much"

Although in theory the wiki provides a complete and easily viewable version history of the construction of the wiki, together with the names of the individual contributors of content, the time taken to review this for each of 50 wiki sections was disproportionate to the overall marking of the wiki and only a cursory analysis of individual contributions was made. This was a weakness in the project that requires further refinement and improvement – most probably through the use of peer assessment.

The last question on the survey was concerned with "What could have been done to better prepare you for using a wiki", see Figure 6 below.

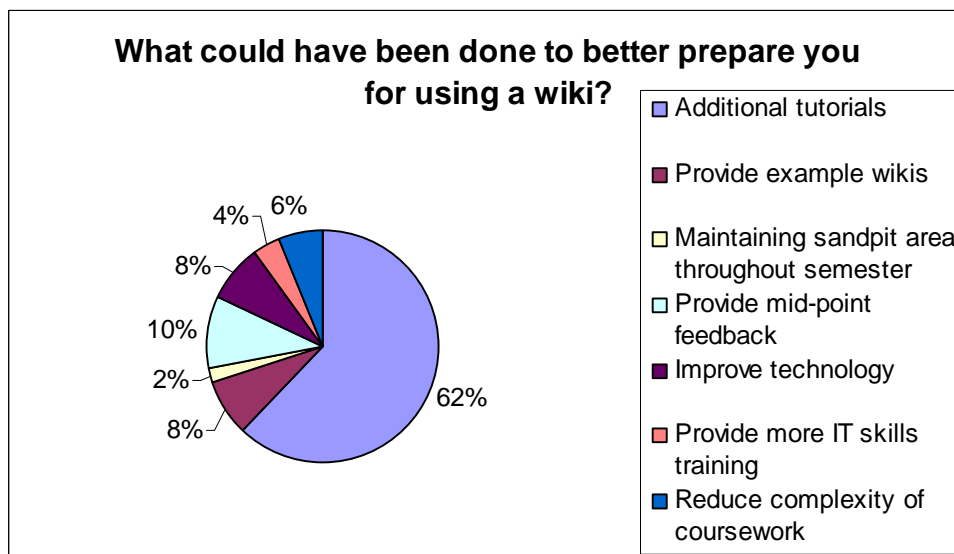


Figure 6: Percentage response to Question 7 of the questionnaire

Sixty two percent of respondents would have liked to see additional tutorials on the wikis, whether in the form of face to face or online video demos. Although the authors provided 2 one hour tutorials, a series of how to guides and the sandpit area, this provision was viewed as inadequate by many students. This finding confirms the views expressed by (Engstrom & Jewett, 2005) and (Cronin, 2009) that it is essential to provide sufficient training if students are to optimise the effectiveness of the wiki as a learning tool. One student commented

"If there was a demonstration in class on how to create a Wiki, it would have been helpful".

A few students requested example wikis to be made available. This request will be granted for future cohorts as the best eight wikis from 2009 will be posted on the Blackboard site as case studies of infrastructure projects. Other requests made by students were for mid point feedback to be provided before submission of the wiki. In a smaller cohort size this would have been possible, but was sacrificed here to provide additional tutorial time for students.

Surprisingly only very few students responses to Question 7 centred on improving the wiki technology (8% of respondents). This low figure is probably explained by the fact that students had already expressed their dissatisfaction with the technology in Question 6 previously.

Reflections and Areas for Future Research

This study provided rich learning for both staff and students alike. It has enabled the authors to construct an understanding of and articulate the pedagogic value of wikis and how they fit into the existing framework of learning theory. Prior to the study the authors considered themselves experienced users of learning technology, competent at using the VLE not simply as a materials repository, but as an assessment and communication tool. Building on this competency the authors wished to explore the potential of wikis as a tool for enhancing collaboration and increasing knowledge and understanding of project finance – particularly in large cohort teaching where logistical pressures often conspire against the delivery of effective learning.

More importantly, this study has enabled the authors to deliver an enhanced learning experience to a cohort of 250 postgraduate students. The findings of this case study demonstrate both the benefits and the issues associated with the implementation of wiki-based coursework in a very large student cohort. Evidence has been provided that that wikis enhanced the students' ability to work collaboratively. Additionally the wiki coursework was seen to help students build relationships; improving cohort cohesion in a large, international full time MSc programme where many of the students are grappling with issues of language, and are adapting to UK culture and a different educational setting. The best wikis have also provided rich course material in the form of project case studies, which will be accessible to future cohorts.

Whilst the project was not without its challenges, particularly in terms of the limitations in the selected wiki technology and its link to the VLE, the authors are hopeful that these will be overcome before the

course is rerun in 2010. We acknowledge too that we did not get everything right. The area of grading individual contributions to the wiki was poorly implemented. There was an over-reliance on being able to assess the number of and quality of individual edits and additions to the wikis and the size of this task was overwhelming. Next year peer assessment of the wikis will be implemented to improve the equity of grading students' contributions and mitigate against individuals shirking. There was also inadequate tutorial time for those students who were struggling with the wikis. Next year small group tutorials will be held mid way through the project, resourced with learning technologists and teaching assistants to ensure that lack of understanding of wikis does not become a barrier to collaborative working.

In spite of these issues, colleagues have enquired about implementing wikis on their modules and the authors have been invited to present their wiki project at a number of University of Manchester events. The authors are keen to share their experiences in these fora and beyond, believing that the learnings from this study are applicable to a broad range of undergraduate and post graduate engineering programmes. Future research will focus on the particular challenges facing collaborative learning on courses dominated by overseas postgraduate students and whether wikis can act as a tool to capture organisational learning in project based organisations.

References

- Berkman, R. (2004) The wild, wonderful, world of wikis. *Knowledge Management: A Quarterly Supplement Exclusively for The Information Advisor Reader* 8 (4), 1-4.
- Biggs, J. (1999) *Teaching for Quality Learning at University*. Buckingham: Society for Research in Higher Education and Open University Press.
- Bold, M. (2006) Use of wikis in graduate course work. *Journal of Interactive Learning Research* 17(1), 5-14.
- Bruner, J. (1960) *The Process of Education*. Cambridge, MA: Harvard University Press.
- Bruns, A. and Humphreys, S (2005) Wikis in teaching and assessment: the M/Cyclopedia project. *2005 International Symposium on Wikis*, 16 - 18 October 2005, San Diego, CA.
- Cole, M. (2009) Using wiki technology to support student engagement: Lessons from the trenches. *Computers and Education* 52, 141-146.
- Cronin, J. (2009) Upgrading to web 2.0: An experiential project to build a marketing wiki. *Journal of Marketing Education* 31(1), 66-75.
- Da Lio, E., Fraboni, L.L. and Leo, T. (2005) TWiki-based facilitation in a newly formed academic community of practice. *2005 International Symposium on Wikis*, 16 -18 October 2005, San Diego, CA.
- Duffy, P., and Bruns, A. (2006) The use of blogs, wikis and RSS in education: A conversation of possibilities. *Proceedings of the Online Learning and Teaching Conference 2006*, 26 September 2006, Brisbane Australia
- Elgort, I., Smith, A. et al. (2008) Is wiki an effective platform for group coursework. *Australasian Journal of Educational Technology* 24(2), 195-210.
- Engineering Council (2004) UK Standard for Professional Engineering Competence, 2004, p11. Available from www.engc.org.uk [accessed 18 January 2010].
- Engstrom, M. E. and Jewett, D. (2005) Collaborative learning: The wiki way. *TechTrends* 49(6), 12-68.
- Ferris, S. and Wilder, H (2006) Uses and potentials of wikis in the classroom. *Innovate* 2(5). Available from http://www.innovateonline.info/pdf/vol2_issue5/Uses_and_Potentials_of_Wikis_in_the_Classroom.pdf [accessed 18 January 2010].
- Gerlach, J. M. (1994) Is this collaboration? In: Bosworth, K. and Hamilton, S.J. (Eds) *Collaborative Learning: Underlying Processes and Effective Techniques, New Directions for Teaching and Learning* No 59.
- Hammond, R. (2007) Party Lines, Wikis and Project Management. *Online* 31(5), 30-33.
- Harris, S. and Zeng, X. (2008) Using Wiki in an online record documentation systems course. *Perspectives in Health Management* 5(1).

- Houghton, W. (2004) Learning and Teaching Theory for Engineering Academics: p27. Available from <http://www.engsc.ac.uk/downloads/scholarart/theory.pdf> [accessed 18 January 2010]
- Johnson, D. W., Johnson, R.T et al. (2007) The state of cooperative learning in post secondary and professional settings. *Educational Psychology Review*(19), 15-29.
- Jonassen, D., Peck, K. et al. (1999) *Learning with Technology: A Constructivist Perspective*. Upper Saddle River, NJ: Prentice Hall.
- Kai Wah Chu, S. (2008) T-Wikis for knowledge building and management. *Online Information Review* 32(6), 745-758.
- Kuiper, E. and Volman, M. (2008) *The Web as a source of information for students in K–12 education*. New York: Lawrence Erlbaum Associates.
- Mason, R. and Rennie, F. (2008) *E-Learning and Social Networking Handbook: Resources for Higher Education*. New York: Routledge(Taylor and Francis Group).
- Matthew, K., Felgevi, E. et al. (2009) Wiki as a Collaborative Learning Tool in a Language Arts Methods Class. *Journal of Research on Technology in Education* 42(1), 51-72.
- McKiernan, G. (2005) Wikimedia Worlds: Part 1 Wikipedia. *Library Hi-Tech News*(8), 46-54.
- Miers, J. (2004) BELTS or Braces? Technology School of the Future. Available from <http://www.teachers.ash.org.au/jmresources/research/04ResearchReport.pdf> [accessed 18 January 2010]
- Mindel, J. and Verma, S. (2006) Wikis for Teaching and Learning. *Communications of AIS* 18(1).
- Moskaliuk, J., Kimmerle, J. et al. (2009) Wiki supported learning and knowledge building: effects of incongruity between knowledge and information. *Journal of Computer Assisted Learning* 25, 549-561.
- Nicol, D., Littlejohn, A. et al. (2005) The importance of structuring information and resources within shared workspaces during collaborative design learning. *Open Learning*. 20(1), 31-49.
- Parker, K. and Chao, J. (2007) Wiki as a Teaching Tool. *Interdisciplinary Journal of Knowledge and Learning Objects* 3.
- Reid, K. and Wilson, G (2007) Dr Project: A software project management portal to meet educational needs. *SIGCSE 07*, 7 -10 March 2007, Covington, Kentucky, USA.
- Ruth, A. and Houghton, L. (2009) The wiki way of learning. *Australasian Journal of Educational Technology* 25(2), 135-152.
- Sfard, A. (1998) On two metaphors for learning and the dangers of choosing just one. *Educational Researcher* 27(2), 4-13.
- Trentin, G. (2008) Using a wiki to evaluate individual contribution to a collaborative learning project. *Journal of Computer Assisted Learning*(25), 43-55.
- Wheeler, S., Yeomans, P., and Wheeler, D. (2008) The good, the bad and the wiki: Evaluating student-generated content for collaborative learning. *British Journal of Educational Technology* 39(6), 987–995.
- Workman, J. (2008) Wikis in the classroom: Opportunities and Challenges. *Marketing Education Review* 18(1), 19-24.

Acknowledgements

This project was supported by the Centre for Excellence in Enquiry Based Learning at The University of Manchester. We would like to thank the students who participated in this study and the reviewers who provided invaluable feedback.

Copyright © 2009 Authors listed on page 1: The authors assign to the EE2010 organisers 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 the Engineering Subject Centre to publish this document in full on the World Wide Web (prime sites and mirrors) on flash memory drive and in printed form within the EE2010 conference proceedings. Any other usage is prohibited without the express permission of the authors.