An Exploratory Study of Personal Reflection and Collaboration Skills using Online Collaborative Tool in Project-Based Learning

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Abstract

By deepening our understanding of the use of Web 2.0 for reflective practice, knowledge co-construction and project based learning this paper aims to contribute to our understanding of collaborative learning. The paper investigates a case study of a post-graduate system development subject to increase student learning through the development of students' personal reflection and collaboration skills. The project aims to develop key foundational knowledge and skills identified in the IS 2010 curriculum guidelines, i.e. the ability to work collaboratively. Of particular interest was the ability of student collaboration combined with personal reflective learning to lead to negotiation of meaning and co-construction of knowledge. A case study approach was used to investigate the use Web 2.0 tools of wikis and blogs to facilitate online collaborative project development. Our result shows that individual learning experience can influence contribution made to team project.

Keywords

Project-based learning, online collaborative tool, team work.

INTRODUCTION

The ability to work collaboratively is one the foundational knowledge and skills identified in the IS 2010 curriculum guidelines (Topi et al., 2010). Extensive research has been conducted on integrating team competencies in IS curricula (Andres and Shipps, 2010; Dishaw et al., 2011; Figl, 2010; Jaeger et al., 2011; Koh and Lim, 2011; Kruck and Teer, 2009). Web 2.0 tools are increasingly being used to support team projects by facilitating collaborative team work and report co-development. The common features of wikis such as shared editing, tracking and page permissions support collaborative learning and team work show potential to enhance learning outcomes (Dishaw et al., 2011; Koh and Lim, 2011; Park et al., 2010).

Research indicates that the success of online learning groups depend on curriculum that facilitates negotiation of meaning and co-construction of knowledge (Hull and Saxon, 2009). Constructivism suggests that learning enables construction of knowledge from experience which is unique to individual (Vygotsky et al., 1978). A collaborative team-based learning environment enables learners to share and compare with other team members what they already know. They negotiate, clarify and explore each other differences and negotiate new meanings of knowledge. During the process they reflect, elaborate, negotiate, co-construct and internalise knowledge as knowledge evolves which leads to deeper learning. The purpose of this paper is to investigate the use of online Web 2.0 tools such as wikis to support the process of negotiation of meaning and co-construction of knowledge in team work project.

The paper is organised as follows. Related literature on team work, wiki, negotiation of meaning, co-construction of knowledge and reflective journal are presented in the next section. This is followed by a description of the research method. Case study background, results and discussions are then presented follows by conclusion.

RELATED LITERATURE

In order to inform development of the project, a range of literature framed within the constructivist perspective was examined. The literature identified relates to collaborative, team-based and reflective learning and the use of Web 2.0 wiki tools. According to the constructivist perspective, individuals construct knowledge by working

to solve realistic problems (Conole et al., 2004; Gupta and Bostrom, 2009). Under this perspective, learning is the process whereby individuals construct new ideas or concepts based on prior knowledge and/or experience. Drawing on works by Johnson and Johnson (1999), Franklin et al. (1976) and Vygotsky et al. (1978), Gupta and Bostrom (2009) propose six team dimensions consisting of positive interdependence, individual accountability, support, development, goal emphasis and team feedback. The definition for each dimension is shown in Figure 1. They conjecture that learning methods manifesting higher levels of structural dimensions will have greater effectiveness in terms of learning outcomes.

Wiki enables group authorship by allowing a group of users to create and edit content easily through a shared workspace. It enables a group of individuals to develop community, discuss an issue of interest and reflect on practice (Gunawardena et al., 2009). It supports a community or group of individuals to move towards collective intelligence in learning environment. In addition to shared editing feature, wiki software also has common communication features such as email, announcements and notifications. Zhang et al. (2011) show that a good collaborative tool that has the capabilities to support (i) ownership with single user login and identity persistence, (ii) easy information access by having features that facilitate search and retrieval, (iii) multiple perspectives by facilitating integration and synthesis of data, and (iv) emergence by facilitating expert flag and notification can affect the team's collaborative processes and thus improving on team performance. Identity ownership and persistence provide contextual information related to user identity to facilitate communication and collaboration. The capability of the system to facilitate search and retrieval enables users to get access to useful contextual information. The capability of the system to recognise and notify users about knowledge change enables team members to use new knowledge to collaborate as well as be able to support evolving nature of knowledge. This feature of the system provides support for negotiation of meaning and co-construction of knowledge in the collaborative learning process.

Team dimensions	Definition
Positive interdependence	Perception of the degree to which participants are linked in a way that some benefits is accrued to the collaborating individual
Individual accountability	Degree to which the performance of each individual participant can be assessed and feedback is seen by team as well as the individual
Support	Degree to which participants offer useful help to fellow team members or provide information that may be useful in understanding the concept
Development	Degree to which the interactions among participants promote an effective working team
Goal emphasis	Degree to which participant behaviour is focussed on accomplishing team goals
Team feedback	Degree to which team members discuss how well they are achieving their goals and maintaining effective working relationships.

Figure 1: Gupta and Bostrom's model of team structural dimensions (Source: Gupta and Bostrom, 2009, p 697)

Koh and Lim (2011) propose a three-level wiki system framework to describe wiki system. A *Level 1* wiki system includes basic features that facilitate asynchronous information exchange such as shared editing, tracking functions and page permission. A *Level 2* wiki system includes features in level 1 plus additional features that improve spontaneous communication such as group chats. A *Level 3* wiki system includes features in levels 1 and 2 and integrates with organisational wide information systems to enable data integration. These functional perspectives of wiki enable interaction processes of team members and wiki effectiveness of collaborative learning to be examined. Koh and Lim's (2011) research show that wiki positively results in learning outcomes, self-reported learning, process satisfaction, positive social environment and a sense of community.

We use the models proposed by Gunawardena et al. (1997, 2009) to examine the level of interaction in collaborative learning environment. Gunawardena et al. (1997) propose a five-stage model consisting of progressive phases in which team members interact and collaborate in a team-based learning environment. Hull and Saxon (2009) explain the five-stage model consisting of (i) sharing and comparing of information, (ii) discovery and exploration of inconsistency among ideas or concepts, (iii) negotiation of meaning and co-construction of knowledge, (iv) testing and modification of proposed synthesis or co-construction, (v) agreement statement and application of newly constructed meaning. In phase one team members share and compare information, observation or opinion. They define, describe and identify problem. They ask and answer questions to clarify statements or observations. In phase two, team members identify and state areas of disagreement, they ask and answer questions to clarify source and extent of disagreement and they may restate their positions by references or through data collection. In phase three, team members negotiate or clarify meaning of terms, further identifying areas of agreement or disagreement, propose and negotiate new statements and co-construct knowledge. In phase four, team members test the new statement against formal model, personal experience and conduct formal data collection to validate new knowledge. In phase five, team members summarise the agreements, co-construct and apply new knowledge. As the team moves through successive stages, their collaborative skills draw upon higher mental functions.

Drawing on the five-stage model above, Gunawardena et al. (2009) propose a theoretical model known as "social networking spiral" to inform our understanding of collaborative learning in a social networking environment. The model consists of six *spiral* stages: context, discourse, action, reflection, reorganisation and socially mediated meta-cognition. The spiral nature of the model indicates the phases are iterative and stages can progress in multiple iterations. Figure 2 describes the five phases of the model. In the context phase, a wiki website is used to define context of the wiki and context of team members using the wiki. In the discourse phase, individual members contribute to the wiki based on their life experience, knowledge and insights. Gunawardena et al. (2009) explain that at this level "negotiation of meaning reinforced the strength of the interaction as a common history began to emerge and members were motivated to contribute" (p. 14). In the action phase, individual members identify a learning goal and with the use of wiki they connect with each other to share that goal. Through wiki individuals contribute knowledge and discuss their findings. In the reflection phase, individual members review and discuss relevant postings in wiki based on their experience and/or prior knowledge. The reflection is characterised by interaction of personal experience and group thinking. Members discuss viewpoints and integrate new knowledge which may result in changing of understanding and co-construction of knowledge at the individual and group levels. The history page and tracking function of wiki facilitate the reflection. In the reorganisation phase individual members bring new insights and are moving toward the shared goals. They adjust their understanding of the knowledge, learn from reflection stage and realign and reorganise their understanding to move toward the shared goal. Collaborative learning is emerging in this phase and individual members may begin a second iteration of action, reflection and reorganisation with new tasks and learning. In the socially mediated meta-cognition phase, individual members critique each other work, offer viewpoint and suggestion to one another to achieve shared understanding by mutually reflecting on own reasoning and developmental process a group. Thus wiki provides a shared space for this purpose. The history page of wiki facilitates this process and enables the tracking function of the development process of shared understanding. Blog within wiki can also serve this purpose. The Level 1 wiki system framework proposed by Koh and Lim (2011) contains features that are appropriate for the first three stages of social networking spiral model and Level 2 wiki system includes features that aid phases 4, 5 and 6 of the model.

Phase	Details
Context	Initiation of collective intelligence creation in social networking environment
Discourse	Negotiation of meaning is developed for participants to bring their life experience, knowledge and insights to the group
Action	Initiation of social mediated cognition in which participants identify a learning goal, connect with each other and agree to tasks to accomplish the goal.
Reflection	Interaction of personal experience and group thinking, consideration and integration of unfamiliar point of view
Reorganisation	Group members adjusts meaning, bring new understanding and insight to advance the share goal
Socially mediated meta-cognition	Group members able to mutually reflect on reasoning and developmental process as a group, exploring each other's reasoning and viewpoints in order to construct a shared understanding

Figure 2: The six-stage of social networking spiral model (Gunawardena et al., 2009)

Within the learning context the relationship between individual reflection and group collaboration is informed by Wheeler's (2010) five-stage wiki activities model that encourages a progression of engagement from individual inquiry to group collaboration. Figure 3 shows the Wheeler five-stage wiki activities model (Wheeler, 2010). In the exploration mode, team members are getting to know each other; for example they post information about themselves to the wiki. In the exhibition mode, team members share their ideas, post useful links related to their project. In the explanation mode, team members begin their posting, describe their views or knowledge they wish to share with the group and may explain the basis of their knowledge or viewpoint. This is followed by the elaboration mode in which team members elaborate their views, justify their decisions and contribute more collaborative postings and may conduct complex editing in the form of critique and feedback. Finally the evaluation mode assesses values, accuracy and significance of the content. As shown in Figure 3 the complexity of activities increases as the mode progresses from exploration to evaluation mode.
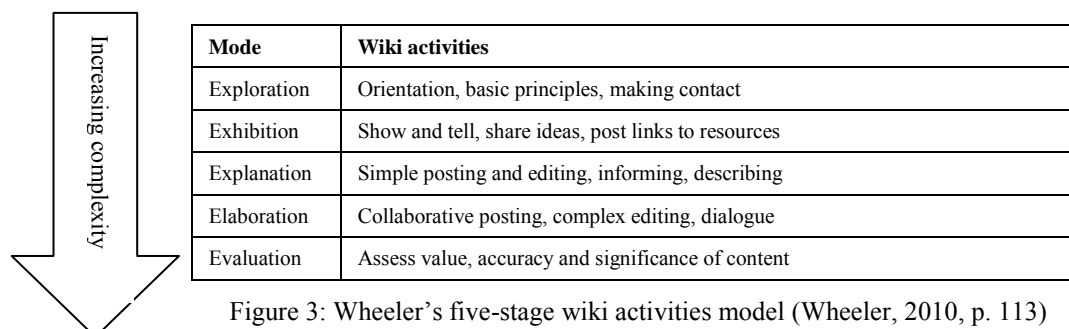
Mode	Wiki activities
Exploration	Orientation, basic principles, making contact
Exhibition	Show and tell, share ideas, post links to resources
Explanation	Simple posting and editing, informing, describing
Elaboration	Collaborative posting, complex editing, dialogue
Evaluation	Assess value, accuracy and significance of content

Increasing complexity

Figure 3: Wheeler's five-stage wiki activities model (Wheeler, 2010, p. 113)

Research has indicated that learning outcomes are influenced by a combination of socio-emotional and task-related activity, with some findings indicating that within learning tasks socio-emotional activity is more significant than task-related activity (Koh and Lim, 2011). Koh and Lim (2011) define task-related activity as "Behaviour that is focused on work. It includes actions such as asking for information and providing information on the task." and socio-emotional activity is defined as "Behaviour that is focused on feelings and the self. It includes expressing affection and sharing personal information." (Koh and Lim, 2011, p. 5). Koh and Lim (2011) explain that learning focusing on task-related activity may lead to increased student satisfaction with the group project and increased learning outcomes, however students may not gain inter-related knowledge from information shared.

A well chosen wiki may influence learning outcomes. A wiki that does not provide enhanced features such as group chat and discussion board may result in team members focus on contributing individual blocks of text and editing the wiki without critical discussion on the rational, thinking process and the validity of ideas. Thus while a wiki may facilitate team members contributions it may not facilitate co-construction of knowledge and negotiate meaning with respect to the intended learning outcomes. A learning task that utilises a Level 3 wiki to facilitate socio-emotional activity may enhance learning outcomes by reducing student isolation and an increasing sense of community. A number of researchers have reinforced the importance of communities for increased learning outcomes. Wenger (1998) emphasises the importance of facilitating the "lived experience" of participants in a community of practice and negotiation of meaning and interaction between participants improves learning. Schippers et al. (2003) explain that communication and conversation is important in increasing the negotiation of meaning.

Relationship between team members can illuminate different ideas that in turn can then be discussed, communicated, negotiated, adapted, reformulated and co-constructed to increase the knowledge beyond the individual viewpoint. Within a learning activity this process can be repeated over several iterations until a shared understanding or a shared goal is achieved. In the online collaborative learning environment Web 2.0 tool such as wiki can provide this platform to communicate, share and collaborate. Team members can post their findings, ideas and comments to the wiki and communicate with their team in order to facilitate the negotiation of meanings and co-construction of knowledge. Research indicates that the learning process is improved by combining collaborative activities with individual reflection (Wheeler, 2010). Figure 4 shows the Wheeler model of negotiation of meaning through shared space. In this model Web 2.0 tools are used to develop the intersecting space between the personal and community space in which meaning is negotiated. Combining the use of a blog as the reflective space and the wiki as the collaborative space facilitates negotiation of meaning. The interaction of reflective and collaborative space is the region in which the learners clarify ideas and negotiate meaning which leads to co-construction of knowledge.
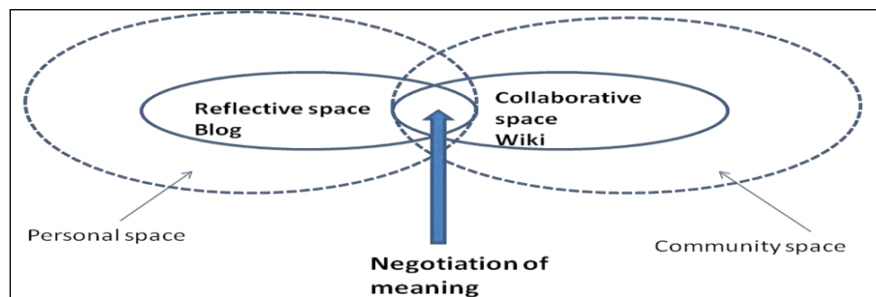

Figure 4: Wheeler's model of negotiation of meaning through shared spaces (Wheeler, 2010, p. 111)

The use of a reflective journal can increase the learning that results from the experiences undertaken (Moon, 2003). Through facilitating the documentation and reflection on ideas developed during the learning experience, journals enable students to record the development of their ideas. Reflection enables students to think about, internally examine and meta-cognitively reflect on the issue triggered via a learning experience. By combining team based activity with individual reflection, collaborative learning can be enhanced. A learning task that encourages team members to reflect on their actions during the team based learning activity has the potential to increase both student satisfaction and learning outcomes.

RESEARCH METHOD

A case study is investigated as a proof-of-concept in this project. A questionnaire was developed to evaluate the learning experience and its influence on contribution made to team work based on Wheeler's five stage wiki activities model. A human research ethics application was submitted to the university and approval was granted to conduct the case study. Participation in the survey was voluntary and all responses were anonymous. The following three research questions were asked:

1. Which stage of the Wheeler's five stage wiki activities model did the students perceive themselves and their team members to be?
2. What are the learning experience in relation to the use of reflective journal and wiki?
3. Does individual learning experience influence contribution made to team project?

CASE STUDY

Background

The case study setting was a post-graduate systems development methodologies subject. Learning outcome of the subject is students able to assess the needs of different systems development projects and select an appropriate system development methodology for the project. The subject is delivered in a weekly three hours face-to-face lecture mode. The following graduate qualities are integrated into the subject: teamwork, innovation and design, informed, independent learners, effective communicator, problem solvers and responsible. Authentic learning principle is integrated into assessment to enable students to immerse in the complexities of system development tasks and involves authentic activities that mirror real-world activities. Authentic assessment encourages divergent thinking in generating possible answers, emphasizes on ensuring proficiency of real-world tasks, promote "how" knowledge, provides an examination of learning over time, emphasizes on cooperation, prepare students for ambiguities and exceptions found in realistic problem settings (Lombardi, 2008)

Wikispaces (www.wikispaces.com) is the wiki system used in this study. Wikispaces is selected because the current eLearning system in the university does not have wiki function and Wikispaces provides free access to educators. Features available in Wikispaces include easy-to-use visual editor, easy navigation tool, customisation of pages using media widgets, wiki-, page- and file-level permission, history page, email communication, discussion forum, notifications, tagging, simultaneous editing, contextual comments and discussions and projects for group work (Wikispaces, 2012). The *project* feature in Wikispaces enables groups to be organised by allocating team members to individual groups which have its own pages, files and permissions. This is a useful feature for team work. Based on Koh and Lim (2011) wiki system classification, Wikispaces is a Level 2 wiki system.

Students enrolled in this subject are international students from diverse cultural background. Davies (2009) explains that culture has some influence on behaviour of groups, in particular cultural and linguistic background can influence the way students respond to group work. Self-selection team formation has its advantage and disadvantage. The advantage is students have the freedom to choose who they want to work with and giving ownership and responsibility of team formation to the students. The disadvantage is students tend to form group with their friends or similar ethnic background which may result in inequity in skills and team formation (Davies, 2009; Kriflik and Mullan, 2007). The instructor in the subject decides to use the self-selection method in team formation with the view that they are post graduate students who should be able to take ownership and responsibility for team formation. The students are asked to form a team consisting between three to five members. There are twenty-one students enrolled in the subject, five teams were formed: one team consists of three members, two teams consist of four members and the remaining two teams are made up of five members.

Each team is asked to submit a tender to develop a web-based system for a fictitious local recruitment agency which recruits temporary positions for local businesses. The requirements of the system include enabling local businesses to submit requests online to fill temporary positions; enabling potential applicants to submit curriculum vitae online; matching of available temporaries with requests submitted by the business; preparing and sending contract online to the business and applicant after the position is filled. User requirements for the case are intentionally vague and ill-defined to reflect the authentic context of real world situation. The project is expected to complete within nine weeks.

There are three deliverables in the assessment. The first deliverable is a tender document to be submitted by each team detailing the skills that the team has (including a curriculum vitae of each team member), budget and project plan and proposed system development methodology to be used and justifications of the choice. In the second deliverable the team is to complete system development of the project, submit system analysis and design report and to present the system at the end of the project. An implementable and workable system is expected. There is no constraint on the choice of software or programming language that the team can use to develop the system. The decision is made by the team and justification of the decision needs to be included in the report. One of the most common reasons is the availability of skill set of team members or the access to the software. The third deliverable is a learning reflective report. There is a weekly progress meeting between manager of the company (which is role-played by the instructor) and the team. During the weekly meeting, the team reports on project progress and project milestone, discusses issues concerning system requirements, demonstrate prototype and obtain user feedback. Each student submits weekly reflective learning journal to the wiki, reflecting their learning experience on the project. To encourage reflective learning journal that reflects

personal learning experience, students are allowed to write the reflective journal in a format of their choice, for example writing the reflective journal in their native language, in audio or video format. The students must upload the reflective journal in any format that they use to the wiki. Then the students are asked to write a final reflective report by selecting two of the weekly journal entries. All deliverables include reports and weekly reflective journals are to be completed using Wikispaces.

Wheeler's (2010) five-stage wiki activity model is adopted for this assessment. The *exploration* mode includes activities for orientation and making contact. This is achieved by students posting their background and curriculum vitae to the group wiki space. The *exhibition* mode is achieved by students sharing ideas about the project with each other, finding useful links related to the project and may also include project planning and allocation activities. The *explanation* mode is achieved when students post their contributions to the report and deliverable to the wiki. They describe their results and inform the progress. To encourage the *elaboration* mode which involves complex editing, collaborative posting and dialogues, students are required to do the following. One week before the report is due for submission, all team members are required to review and critique work completed by another team member and to revise the work if necessary. Each team is asked to take a "snapshot" of the work prior to the review process (for example by saving the file as a pdf document or save the file using a different filename). The *comment* feature within the editor in the Wikispaces can be used for this purpose to enable students to post their comment, suggestion or critique. Students can also use the discussion forum for this purpose. Each student must select a portion of the work completed by another team member to perform this task. Finally the *evaluation* mode is achieved by students complete the review process, revise the report to ensure accuracy and submit the final report for assessment.

Results

In this section, we discuss our findings with the aim to answer the three research questions presented in the research method section. There were twenty-one students enrolled in the subject; fourteen students completed the survey. One student has only partially completed the questionnaire and the response was removed from analysis. Thus the analysis was based on a sample size of thirteen students. Due to the small sample size, the results reported here are largely exploratory.

1. Which stage of the Wheeler's five stage wiki activities model did the students perceive themselves and their team members to be?

Figure 5 shows perceptions of students on their own contributions and that of their team members based on the Wheeler's five stage wiki activities model. The results show that most students think that by using wiki they have contributed to the team project through the *elaboration* mode of the Wheeler's model, which is "collaboratively developed ideas with others; undertook complex editing and discussion". This result can be explained by students were given the task to review and critique the work prepared by other team members before submission. However they have thought that other team members have contributed in the *explanation* mode which is described as "shared basic understanding and description of the problem". Figure 6 shows the frequency of using reflective journal and contributing to wiki. It can be seen that majority of students have used reflective journal on a weekly basis and they have also contributed to the wiki weekly.
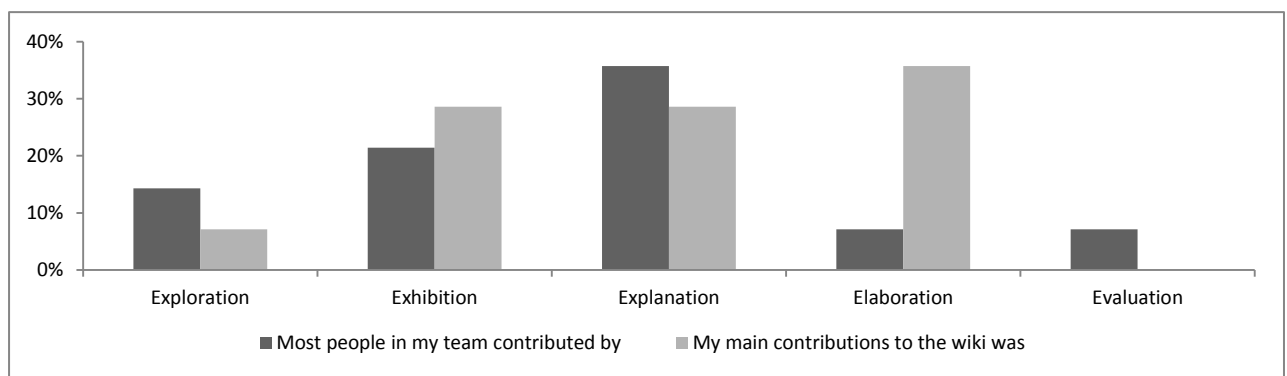

Figure 5: Perceptions of students on their own contributions and that of their team members based on Wheeler's five-stage wiki activities model
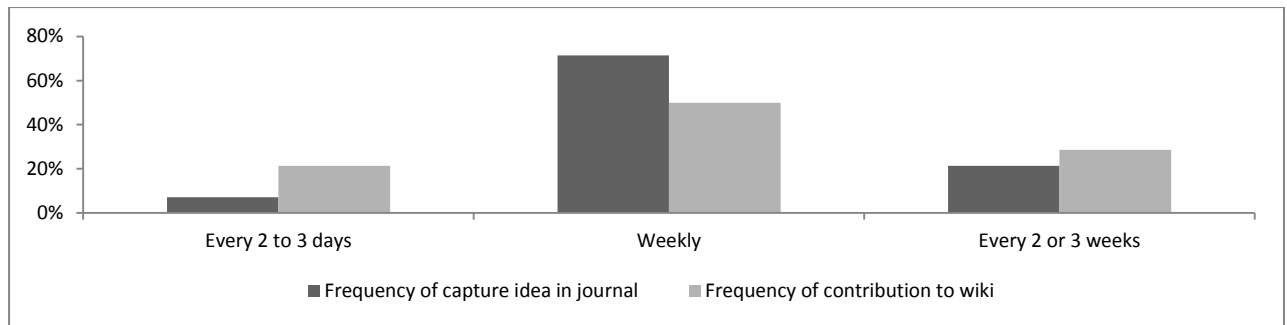
Figure 6: Frequency of using reflective journal and contributing to wiki

2. What are the learning experience in relation to the use of reflective journal and wiki?

A survey questionnaire consisting of eighteen items (see Table 1) with a Likert scale of 1 to 5 (from 1 = strongly disagree to 5 = strongly agree) was administered. Cronbach's alpha was computed to measure internal consistency of these questions, a coefficient of 0.72 was found indicating reliability of the questions (Bland and Altman, 1997). We have used descriptive statistics to analyse the data. Table 1 shows the results of the eighteen questions. Note that Likert scales are ordinal data therefore mode is computed instead of mean (Clason and Dormody, 1994; Jamieson, 2004).

Table 1: Results on learning experience in relation to the use of reflective journal and wiki
(* *Questions that were worded negatively*)

Questions	Mode
I have used a journal in the past	4
I was enthusiastic about using a journal because it would help me to see how my professional skills in team work has improved	4
The journal helped me think about and clarify my individual ideas	4
I have never used collaborative online tools to develop and plan projects in the past *	2
I was worried about using the online collaborative tool (wiki) to share and develop ideas with my team *	3
The online collaborative tool (wiki) helped me think about and clarify my individual ideas	3
The appearance of the wiki tool was adequate.	3
I found navigating the online wiki simple	4
Using the reflective journal improved my critical thinking skills.	4
The reflective journal aided my analytical skills	4
I worked closely with my team members throughout the 9 weeks of the project	4
The project plan and milestones my team negotiated have been followed exactly	4
The online tool restricted my team's ability to work together towards a group solution to the problem *	4
I felt that my contribution and partnership in a team improved my performance	4
Working with a team restricted my ability to demonstrate my knowledge of this subject *	2
I am more confident in expressing my ideas to a team	4
Participation in the online activity made me feel isolated from my classmates *	2
My skills in coordinating a team-based activity have improved	4

3. Does individual learning experience influence contribution made to team project?

To answer this research, the following two hypotheses were tested:

H1: Individual learning experience can influence contribution made to the team project.

H2: Individual learning experience can influence contribution made by other team members to the team project.

We categorise learning experience as negative, neutral and positive based on the mode value of the eighteen questions used in the questionnaire described in research question 2. A mode of 1 or 2 is categorised as negative, 3 as neutral and 4 or 5 as positive. The contribution made to the team project is identified using Wheeler's five-stage wiki activities model as described in research question 1 above. Due to the small sample size, Fisher's exact test was used instead of Chi-square test (Campbell, 2007). For H1 the result shows p=0.59 therefore H1 is not rejected at 0.05 significant level. This result indicates individual learning experience can influence contribution made to the team project. For H2, the result shows p=0.038 therefore H2 is rejected at 0.05 significant level indicating individual learning experience cannot influence contribution made by other team members to the team project.

Discussion

Results from this case study show students participated in the *elaboration* mode of the Wheeler's five-stage wiki activities model; however there is no evidence that the *evaluation* mode is achieved. This can be explained by

students are expecting the instructor to assess the quality and accuracy of their work. To overcome this shortcoming, peer assessment of work completed by other teams may be designed in future. The *elaboration* mode of the Wheeler's model which enables team members to elaborate their contributions or postings to the wiki through collaborative posting, complex editing and dialogue supports this finding. Our result shows that individual learning experience can influence contribution made to team project; however it does not influence contribution made by other team members to the project.

Zhang et al. (2011) have shown that team performance is driven by the capability of team members to collaborate and assimilate knowledge. Students need to be taught to work in a team in order to achieve deep learning. Thus simply by providing team work opportunity and team work project without taking into consideration of teaching and learning strategies through progressive knowledge development is undesirable. As Wheeler (2010) explains "the most powerful region for change through negotiation of meaning and the resultant co-construction of knowledge is at the nexus between the spaces – the point where students may be uncertain about how they will proceed or what stance they should adopt" (Wheeler, 2010, p. 110).

In most cases reflective journal writing show limited personal reflection. Many students use it as a notebook summarizing weekly lecture content and describing tasks performed in the project. This observation is consistent with experience reported in the literature such as Lai and Calandra (2007). In this case there may not be sufficient evidence to show that negotiation of meaning was achieved via the shared space of Wheeler's model of negotiation of meaning as shown in Figure 4. One of the strategies to improve the reflective learning process is to create scaffoldings for the reflective learning process and to provide a model of a reflective journal. Ideally the reflective learning journal should progressively and critically reflect on own processes and experiences of learning (Moon, 2003). The experiential learning model proposed by Kolb (1984) can be adopted to achieve this goal. The model consists of four stages: concrete experience, reflective observation, abstract conceptualisation and active experimentation (Kolb, 1984). It is not sufficient to have experience in order to learn; on the other hand it is necessary to reflect on the experience, formulate abstract concepts and apply to new situations. Through reflective learning and negotiation of meaning, a reflective journal can be used as a tool to enable students to co-construct knowledge in a collaborative learning environment. For the teaching and learning perspective, learning scaffolding expressed in the form of assessments for reflective journal writing tasks may serve the purpose.

As part of the survey, students are also asked to provide suggestion on how to improve performance of their team and how to improve their reflective journal. Their suggestions can be categorised into the following themes: planning, meetings, communication, sharing and listening. Planning and meetings are the two themes identified by most of the students to improve team performance. In relation to questions on how to improve their reflective journal, recommendations include writing the journal at regular intervals (such as weekly and preferably promptly after the meeting or class) and do not copy journal entry of another student. Although students were encouraged to record their reflections in a format appropriate for themselves, only two students recorded ideas in alternative formats, one in Chinese language and another using the smart phone to record images of group notes.

CONCLUSION

Project team-based learning described in this paper has shown Web 2.0 has the potential to support team work, authentic assessment and project-based learning. This study follows a constructivism approach which gives students opportunity for concrete, contextually meaningful experience through which they can construct their own mental and learning models. It encourages students to take ownership of ideas and engage in learning activity and reflection. Our result shows that individual learning experience can influence contribution made to team project; however it does not influence contribution made by other team members to the project.

This paper reaffirms Wheeler's view that synthesis of knowledge arising from negotiation of meaning is a powerful way to co-construct knowledge (Wheeler, 2010). Knowledge development is achieved through personal reflection on ideas and negotiating with each other to lead to deeper understanding and meaning. The process of negotiation of meaning is achieved by combining group and individual activities of analysing, designing and developing a system. This results in co-construction of knowledge throughout the team project.

Information systems projects are designed and implemented by groups of professionals working together as a team. Thus students need to learn the mechanics and dynamics of effective team participation as part of their education. Web 2.0 tools such as wiki can be adopted as a mean to deeper learning outcome. Understanding practices on using online collaborative tools for reflective practice, knowledge co-construction and collaborative learning could lead to improvement of team work and is the contribution of this paper.

This project is in early development. There is a need to improve student understanding of a reflection and learning tool and to refine learning model. Evaluation needs to be expanded to enable textual analysis of journal entries to further explore the development of individual reflection and its role in individual knowledge development and co-construction of knowledge. Further investigation on intersection of personal and collaborative space and negotiation of meaning should be explored in future research.

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