A Case Study of Wikis' Effects on Online Transactional Interactions

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Abstract

Increasing interactions between learners and instructors is critical to help learners attain learning outcomes in online learning. Wikis, among a suite of Web 2.0 emerging learning technologies, are suggested to be effective in enhancing online interactions by mediating collaborative knowledge development processes. To enable online instructors to confidently utilize wikis to enhance online interactions, existing online learning theories must be applied to examine learning activities in wikis. Therefore this exploratory case study, grounded in transactional interactions, observed a graduate level learning module on (1) what activities learners experienced and (2) how they interacted with their peers and the instructor in an educational wiki. The collected responses indicated that learners perceived a significantly higher level of online interaction with their peers than did with the instructor. Their responses further revealed their activity patterns in accomplishing the weekly wiki assignments. The study suggested that the role of interactions in the wiki might differ from those seen in other online learning tools (e.g., e-mails, online discussion forums) due to its unique utilities. Online instructors also need to implement strategies that consistently support learners' wiki activities while allowing learner autonomy in order to support authentic wiki collaboration experiences.

Keywords: Online interaction, wiki, transactional interaction, collaborative learning, collective knowledge development

Introduction

Higher education is seeing an inevitable demand for online learning made possible by existing communication and information technology (Instructional Technology Council, 2007 & 2008). A critical strategy to achieve intended learning outcome in this relatively new area is to increase Learner-to-Learner and Learner-to-Instructor interactions (Dennen, Darabi, & Smith, 2007; Arbaugh & Benbunan-Fich, 2007). Because of its potential to promote interactions between learners and instructors, emerging learning technology, or Web 2.0 technology, is gaining a tremendous amount of attention in online teaching and learning (Beldarrian, 2006). Although Web 2.0 technology includes such tools as blogs, RSS (Really Simple Syndication), video sharing and more, it is the wiki, in particular, that is known for its effectiveness in promoting interactions that require collaborative efforts and collective knowledge construction (Goodwin-Jones, 2003; Monicha, & Thomas, 2007; Sandars, 2007; Trentin, 2009). A wiki, unique in its utility, which allows multiple users to review and modify the content on a collection of web pages synchronously and asynchronously (Sandars, 2007), is in this way able to support collaborative content-building experience for all participants in the learning process (Shih, Tseng, & Yang, 2008). Existing research concerning wiki's impact on online learning, however, lacks transparency on what activities learners carry out in wikis and those activities' impact on online interaction (Trentin, 2009).

Moreover, wikis provide rich opportunities for online instructors and researchers to advance current conceptual frameworks that strive to enhance online learning experiences. Benson and Samarawickrema (2007 & 2009) argued that wikis enable learners' proactive contribution to online learning processes that was impossible before. As a result online interactions between learners and their instructors, in support of factors that influence learners' perceived transactional distance (dialog, structure, and learner autonomy)(Moore, 1972; 1989; 1993; 1997), need to be further investigated in wiki-based environments because learners might take a more active role during the online learning process. To preliminarily initiate the inquiry, at first one must understand what activities learners conduct while using wikis to accomplish collaborative projects for learning. Sajjapanroj, Bonk, Lee, and Lin (2008) revealed that activities wiki

contributors experience could be very complex and demanding by surveying groups of Wikibookians. Furthermore, the perceived interaction level between learners and instructors in a wiki needs additional investigation since current findings remain inconclusive (Beldarrian, 2006; Benson & Samarawickrema, 2007; Wheeler, Yeomans, & Wheeler, 2008). Therefore, this study aimed to understand: (1) what activities online learners conducted and participated in using wiki and (2) how learners perceived the level of interaction with their peers and instructor during the learning process.

The following sections firstly describe the role of interaction in online learning based on the framework of transactional interaction derived from the theory of transactional distance (Moore, 1972; 1989; 1993; 1997). Second, the author discusses how wikis could be applied in online learning to enhance interaction and its limitations. Finally the paper describes the methodology and how the findings inform the practical integration of using wikis to enhance online learning experiences.

Literature Survey

Interaction in Online Learning

In online learning the theory of transactional distance offers explanations to the psychological gap between learners and the instructor during the learning process and its relationship with learning outcome. A smaller psychological gap, or a shorter transactional distance, should lead to a better learning outcome whether it is behavioral, cognitive, attitudinal, or a blend of all. Moore (1972; 1989; 1993; 1997) describes the concept of transactional distance (TD) broadly as learners' perceived proximity with their instructor as the result of participating in the learning and communication process. This proximity is irrelevant to the physical as well as temporal distance between the learner and the instructor (Moore, 1993). In order to achieve desired learning outcomes, both the learner and the instructor should decrease the transactional distance via the instructor and the learner initiating and participating in *dialogs* (D) in the forms of interaction, the instructor developing and the learner following the *structure* of the course content and delivery (S), and the instructor enabling and the learner exercising *autonomy* (A). The theory suggests that high levels of dialog (D+) can decrease the transactional distance (TD-). A low level of dialogue (D-), on the other hand, might impede the learning process by increasing the transactional distance (TD+)(Benson & Samarawickrema, 2009; Moore, 1997). The course structure is suggested to directly contribute to the level of dialog instead of the overall transactional distance (Gorsky & Caspi, 2005) implying a hierarchical relationship between dialog (D) and structure (S). Dialog's role in influencing the transactional distance therefore becomes critical. The level of learner autonomy (A), however, could either positively or negatively impact the perceived transactional distance, depending on the context in which the learning occurs (Benson & Samarawickrema, 2009). The theory's ability to generate predictable empirical outcome still remains inconclusive. Gorsky and Caspi (2005) found that the empirical relationship between transactional distance and its variables (dialog, structure, and autonomy) has yet to be properly validated as a whole due to inconsistent interpretations of the operational terms for research across studies.

In an effort to clarify the definitions of transactional distance variables, Moore (1989) proposed three types of interaction in an editorial: (1) Learner-Content interaction, (2) Learner-Instructor interaction, and (3) Learner-Learner interaction. Although Moore did not explicitly state it, some considered them as "transactional interactions" and suggested that Learner-Instructor interaction mainly supports the dialog aspect of transactional distance (Benson & Samarawickrema, 2009, p. 8). The Learner-Content interaction occurs between the learner and the instructional content. Dr. Moore considered it the essential component of education in that learners must receive information from the subject of the study. The Learner-Instructor interaction focuses not only on the delivery of the instruction, but also on the preparation of the courses or programs. Instructors are responsible for maintaining and enhancing the learner's motivation and interests by purposefully devising information presentation, conducting instructional activities, providing application opportunities to learners, and giving feedback based on the learner's performance. This type of interaction encompasses all activities between the learner and the instructor during the instructional process. The Learner-Learner interaction, in Moore's description, comprises of interactions with their peer individuals and groups. The value of Learner-Learner interaction in enhancing the learning experience, however, depends on the learner's age, experience, and abilities to learn autonomously. As online learning is mediated via technologies, Hillman, Willis, and Gunawardena (1994) proposed the fourth interaction type with the technology interface including mediated synchronous discussion (e.g. video conferencing), mediated asynchronous dialogue (e.g. e-mail, discussion postings),

and getting feedback from systems (e.g. interactive computer programs)(Anderson, 2003; Kearsley, 2000).

Some further elaborate the definition of interaction in online teaching and learning as a process in which shared events take place between learners, instructors, and learning environments to help learners achieve intended learning goals (Arbaugh & Benbunan-Fich, 2007). Which is regarded as an essential factor to enhance, thus improving online learning quality (Gunawardena & McIsaac, 2003; Moore, 1997; Wagner, 1994; Vrasidas, 2000). A high level of interactions between *Learners and Learners* (L-L) and *Learners and Instructors* (L-I) might contribute to satisfactory online learning experiences (Arbaugh, 2000 & 2007). By surveying 170 students and 32 instructors in an online program, Dennen, Darabi, and Smith (2007) concluded that the Learner- Instructor interaction, if managed properly, could substantially impact the learner's perceived learning satisfaction. Marks, Sibley, & Arbaugh (2005) identified Learner-Instructor interaction as the main factor in improving the overall quality of online learning. In examining 40 online MBA courses Arbaugh and Benbunan-Fich (2007) also reached a similar conclusion. Learners also perceived a high quality of learning processes as a result of frequent interactions not only with their instructors, but also with other learners (Swan, 2001; Vrasidas & McIsaac, 1999). Such interactions might have positive effects on learners' higher order thinking development (Garrison, Anderson, & Archer, 2001). Fredericksen, Pickett, Shea, Pelz, and Swan (2000) found that students' high level of interaction with their online peers is an important factor for their successful online learning. In summary, interactions with peers and instructors in online learning are collectively essential for learners to acquire satisfactory learning experiences. Their roles as transactional interactions to shorten the transactional distance (TD-) could be promising.

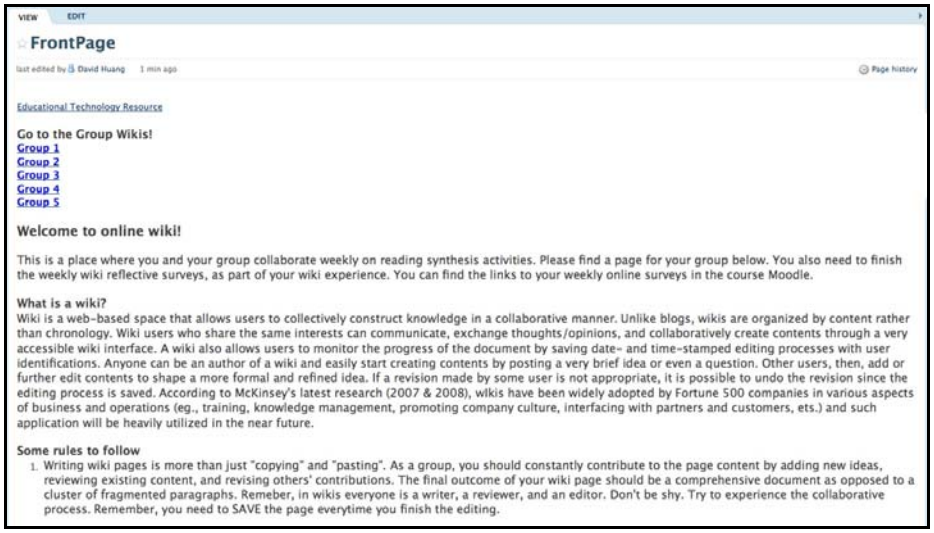
The aforementioned findings, however, were mostly concluded based on the online learning structure pre-determined by the instructor and supported by pre-Web 2.0 technology (e.g., e-mails, online discussion forums, online chat). Learners' roles therefore were only to follow the course structure (assignments, scheduled events) with a minimal need to dialog with the instructor and their peers. With today's Web 2.0 emerging technology learners are able to contribute to the development and the delivery of online learning. Both learners and the instructor might play equal roles in influencing the transactional interaction. Using wiki as a example, Benson & Brack (2009, p.74) suggested that interactions between learners and the instructor need to be revisited as wikis provide platforms that allow learners to actively contribute to the collective knowledge building process with their peers and the instructor (Beldarrian, 2006; Lundin, 2008). In other words, online learners now have the opportunity, during the online learning process, to co-create the course structure with their peers and the instructor. Such process could very likely change the habitual role of transactional interactions in influencing the transactional distance.

Using Wikis to Increase and Sustain Interactions in Online Learning

In recent years, new and emerging technology tools, such as blogs, RSS, online video sharing, and wikis, give educators the means to provide interactive and collaborative learning activities to engage students in higher education (Johnson, Levine, & Smith, 2008 & 2009). These tools provide opportunities for synchronous and asynchronous Learner-Instructor and Learner-Learner interactions that help learners feel involved in the learning process (Beldarrain, 2006; Trentin, 2009).

Due to several key reasons, wikis, in particular, are frequently used to promote group-based collaborative learning (Lundin, 2008; Yan, 2008). *First*, unlike blogs, wikis are organized by topics of interests rather than chronological order of postings, and are composed by groups of contributors instead of single blog writers (Engstrom & Jewett, 2005; Goodwin-Jones, 2003). Wiki contributors who share the same interests can communicate, exchange thoughts/opinions, and collaboratively create contents through an accessible wiki interface online in the form of wiki pages or documents. Instead of displaying all independent comments on a long list seen in blogs, or lengthy and cascading treads in online discussion forums, wiki pages and documents enable users to integrate all contributors' input and present their collective work as comprehensive and succinct documents. Although blogs display every individual viewer's comments, they seldom consolidate viewers' input with integral and coherent manners. *Second*, a wiki allows users to monitor the progress of the document by saving date- and time-stamped editing processes with user identifications. Under this mechanism anyone can be a contributor of a wiki document and easily start creating contents by posting a brief idea while getting acknowledged by peer contributors. Other contributors then add or further edit the content to refine or expand the idea. If a revision made by another user is inappropriate, it is possible to undo the revision since the editing process is always archived. All these activities are constantly ongoing and governed by dynamic

interactions among autonomous contributors. For instance, on PBworks (http://www.PBworks.com), the largest workplace wiki provider in the United States (PRLEAP, 2008), users can access page history to review how often users accessed the page and how much content they edited or revised. Figures 1 and 2 illustrate the viewing and editing modes of PBworks, respectively. Users even can compare the different versions of the document and understand how the page content has progressed. Users are also able to manage the privacy setting of the wiki pages and in educational settings this feature is critical. Educators can easily set up semi-open wikis that grant access to participating students only instead of allowing everyone on the Internet to view, modify, and contribute to the content. *Finally*, the utilization of new technologies for collaborative online learning is in accord with social learning theories as online collaboration promotes higher social engagement level among learners (Shen, Hiltz, & Bieber, 2006). Baird and Fisher (2005) suggested that a wiki provides learner-centered environments in which learners can interact with others synchronously or asynchronously, collaboratively solve problems at their own pace, provide instant feedback to each other, clarify misunderstandings, and construct their knowledge base. Learners, therefore, can learn what they would like to learn in the constructive and collective manner.


VIEW EDIT

FrontPage

last edited by David Huang 1 min ago Page history

Educational Technology Resource

Go to the Group Wikis!
Group 1
Group 2
Group 3
Group 4
Group 5

Welcome to online wiki!

This is a place where you and your group collaborate weekly on reading synthesis activities. Please find a page for your group below. You also need to finish the weekly wiki reflective surveys, as part of your wiki experience. You can find the links to your weekly online surveys in the course Moodle.

What is a wiki?
Wiki is a web-based space that allows users to collectively construct knowledge in a collaborative manner. Unlike blogs, wikis are organized by content rather than chronology. Wiki users who share the same interests can communicate, exchange thoughts/opinions, and collaboratively create contents through a very accessible wiki interface. A wiki also allows users to monitor the progress of the document by saving date- and time-stamped editing processes with user identifications. Anyone can be an author of a wiki and easily start creating contents by posting a very brief idea or even a question. Other users, then, add or further edit contents to shape a more formal and refined idea. If a revision made by some user is not appropriate, it is possible to undo the revision since the editing process is saved. According to McKinsey's latest research (2007 & 2008), wikis have been widely adopted by Fortune 500 companies in various aspects of business and operations (eg., training, knowledge management, promoting company culture, interfacing with partners and customers, ets.) and such application will be heavily utilized in the near future.

Some rules to follow
1. Writing wiki pages is more than just "copying" and "pasting". As a group, you should constantly contribute to the page content by adding new ideas, reviewing existing content, and revising others' contributions. The final outcome of your wiki page should be a comprehensive document as opposed to a cluster of fragmented paragraphs. Remeber, in wikis everyone is a writer, a reviewer, and an editor. Don't be shy. Try to experience the collaborative process. Remember, you need to SAVE the page everytime you finish the editing.

Figure 1. The viewing mode of PBworks.

Cautions also need to be taken when integrating wikis for online teaching and learning. Wheeler, et al. (2008), based on a case study, identified numerous issues with the use of wikis in an undergraduate program. Students reportedly were frustrated by the complex structure of the wikis and apprehended by the openness and high-level participation requirement inherent with wikis. The study also concluded that students with less prior experience in collaborative writing might need more scaffolding from the faculty in the beginning of the wiki writing process. The inclusion of learning style analysis while planning the use of wikis for instructional purposes was suggested (Baird & Fisher, 2005). It is also necessary to consider technology-related issues pertaining to the administration of wiki-based environments (Engstrom & Jewett, 2005). By surveying groups of wiki contributors, the researchers acknowledged that social negotiation and apprenticeship opportunities might impact the overall interaction in wikis (Sajjapanroj, Bonk, Lee, & Lin, 2008). Perhaps the most pressing difficulty in promoting wikis to enhance online learning interaction is the lack of empirical connections between the usage of wikis and how such application might change students interact in natural online learning settings. Thus, it is imperative to reveal what activities learners initiate and participate in using wikis (Trentin, 2009).

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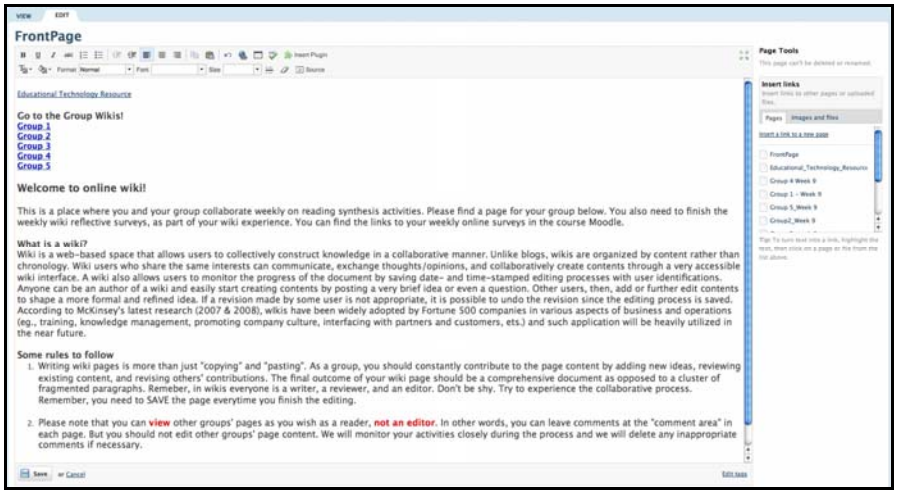

Figure 2. The editing mode of PBworks.

Investigating Interaction Level and Learners' Processes in Wikis

This study, drawn from a naturalistic observation method that focuses on participants' natural behaviors when using new technologies (Garthwait, 2007), aimed to answer two key questions. First, in the wiki environment, what activities did learners initiate, and in which did they participate? Second, what are the interaction levels between Learner and Learner, and interaction levels between Learner and Instructor while using wiki for learning tasks?

In terms of the activity inquiry, studies from Sajjapanroj, et al. (2008), Shin, et al. (2008), Trentin (2009), and Yan (2008) were reviewed in order to identify a list of generic activities wiki users might implement during the collaboration. The list was designed to decipher participants' open-ended responses based on their wiki experiences. For the inquiry on interaction level this case study employed the survey by Arbaugh and Benbunan-Fich (2007) with minor modification. Because wikis are suggested to enhance collaborative activities between learners (O'Shea, Baker, Allen, Curry-Corcoran, & Allen, 2007) and enable learners to contribute to course structure with a higher autonomy level (Benson & Samarawickrema, 2007 & 2009), instructors might play a less-active role during the learning process thus the interaction between learners and the instructor might be of a secondary concern when learning in wikis. Therefore this study also explored whether or not there is a difference between Learner-Learner and Learner-Instructor interaction levels based on students' natural learning activities when using wikis.

Methodology

Participants and Procedures

Sixteen graduate students, enrolled in an instructional technology design course from a Masters program offered by a public university in the United States, participated in the study. This required course focused on topics of E-Learning design in general. Students were required to finish weekly reading assignments covering multimedia learning theories, cognitive load design framework, and practical E-Learning design strategies. To demonstrate their understanding of the reading, students used *PBworks* (http://www.pbworks.com) to complete weekly reading synthesis in small groups randomly assigned by the instructor. All groups had their own semi-open wiki pages and students were encouraged to comment on other group's wiki pages. Only participating students and the instructor can access the wiki pages to

ensure their privacy was protected in the class. The instructor provided weekly synthesis topics based on the reading assignments. Students must address the weekly topic by composing a comprehensive wiki document based on the reading assignments. The length of the weekly synthesis cannot exceed predetermined word limits, which varied from week to week based on the difficulty level of assigned readings. See Table 1 for weekly synthesis topics and word limits. Total points of the weekly reading synthesis assignments contributed to 20% of the final grade.

After the completion of weekly reading synthesis, participants took required weekly online reflective surveys individually as part of the course assignment. The purpose was for learners to recall and reflect upon wiki activities they initiated and in which they participated in the past week. The reflective survey first asked them to describe what they had done in the past week regarding the wiki reading synthesis, followed by an interaction level survey. Learners also received weekly feedback from the course instructor on each week's reading synthesis.

Table 1. Weekly Reading Synthesis Topic

Week	Reading Synthesis Topic	Word Limit
1	No reading assignment.	N/A
2	What is learning/instructional technology?	1,000
3	Compare the Cognitive Load Theory with discussions on cognitive information processing.	1,200
4	What is 4C/ID-model?	750
5	How to apply modality principles when designing do-type activities?	600
6	What is the difference between games and simulation for instructional purposes?	600
7	Provide an example of a connect-type activity you have experienced and discuss its pros and cons.	600
8	Discuss the power of multimedia examples in E-Learning.	1,000
9	Design principles of virtual classroom are…. E-Learning does build problem-solving skills because….	600
10	No reading assignment.	N/A

Instrumentation

The entire survey was hosted by an online survey provider and allowed participants to easily access the survey at their convenience. The online survey consisted of (1) a reflective question and (2) items measuring interaction level. Participants must finish responding to the reflective question before accessing the interaction level survey.

Reflective questions

In this section participants were asked to reflect upon their wiki-related activities in the past week by describing what they did in the past week in order to finish the wiki assignment. A categorizing system was devised based on previous studies (Sajjapanroj, et al., 2008; Shin, et al., 2008; Trentin, 2009;Yan, 2008). Nine categories were identified (see Table 3 for response examples):

1) Time management (e.g., planning for team meeting)
2) Task delegation (e.g., task assignment for team members)
3) Interacting with students/peers (e.g., emailing, communicating)

4) Interacting with instructor(s) (e.g., reviewing instructors' feedback)
5) Searching and reading information related to the topic (e.g., researching on certain topics or complete the reading assignments)
6) Learning how to use Wiki (e.g., how to modify Wiki pages)
7) Writing for your original Wiki postings (e.g., posted my contribution to wiki)
8) Reviewing others' Wiki contribution (e.g., revising, reviewing, rewriting)
9) Other

Interaction level survey

Based on the raw instrument by Arbaugh and Benbunan-Fich (2007) in investigating interaction levels in online learning programs using participants from 40 online MBA courses, the modified interaction level survey consisted of 24 items using a 7-point Likert scale (1: Strongly Disagree ~ 7: Strongly Agree). In all, 12 items targeted the "Learner-Learner interaction" while the other 12 items were coded as "Learner-Instructor interaction". See Table 2 for the survey items with corresponding categories.

Results

Activities in Using Wikis

All responses to the reflective survey were coded by the aforementioned categorizing system. If participants mentioned certain activities more than once in the response it would only be counted as one event if all the statements referred to the same activity. Two trained coders were invited to analyze the data from open-ended responses. Inter-reliability analysis reported a Kappa = .71 to indicate an acceptable consensus level between coders (Cohen, 1960; Tinsley & Weiss, 2000, p.98).

Most interactions between learners related to task delegation (e.g., who to do what) occurred in the beginning weeks of the course, while learners rarely interacted with the instructor. Learners also invested a lot of effort gathering information by finishing reading assignments as and searching for information extensively on the Internet. The writing and reviewing were reported rather consistently in the first six weeks of the synthesis activities. All activities related to learning how to use the interface (PBworks) were reported in the first synthesis activity. Likewise, learners conducted relatively fewer activities specifically on individual and team time management than other activity categories. With regards to the "Other" category, participants reported numerous spontaneous reflective activities as part of the synthesizing process. Table 3 shows examples of reflective responses. Coding results are presented in Table 4.

Interaction Levels on Learner-Learner and Learner-Instructor

Results of reliability analysis reported that the alpha value of items measuring interaction between learners was .75 while between learners and the instructor was .87. In order to understand whether or not the interaction level of Learner-Learner differs from Learner-Instructor on wiki, based on participants' reporting in eight weeks, a paired-sample *t*-test was conducted and results revealed a significant difference ($t = 15.29$, $p < .01$) between the overall levels of interaction between Learner-Learner (M= 4.66, SD=.81) and Learner-Instructor (M= 3.18, SD= 1.0) (See Table 5), which suggested the interaction level between Learner-Learner and Learner-Instructor was different. With regards to the weekly learner interaction level, no significant difference was found on learners' interaction level from all paired comparisons. Interaction level between learners and the instructor, however, suggested a decreasing trend from Week 2 to Week 9.

Discussion

Considering the small sample size, the exploratory nature of this study, and the data was composed by students' natural responses in a non-controlled instructional setting, one must be cautious when applying our finding to other online instructional settings. Our results, nevertheless, suggested that Learner-Learner interaction level was higher than Learner-Instructor interaction level when using PBworks for assigned weekly reading synthesis activities. The weekly interaction levels suggested that learners managed to maintain their interaction level with their peers throughout the eight-week period. The finding, to certain extent, validated previous literature's anecdotal assumptions that wikis might promote collaborations between learners. The findings from the reflective responses further provided insights on how learners actually behaved in wikis thus helping instructors to better design and manage learning processes in wikis.

Table 2. Survey Items and Categories on Interaction Level

	Interaction Level Survey Items	Category
1	The level of interaction between participants was high.	Learner-Learner
2	In general, the instructor was effective in motivating the students to interact in wiki.	Learner-Instructor
3	Student-instructor interaction was more challenging than in other online learning tools I have used.	Learner-Instructor
4	The instructor frequently offered opinions to students based on their contribution in wiki.	Learner-Instructor
5	Students often stated their opinions to the instructor about using wiki.	Learner-Instructor
6	Students often asked the instructor questions about using wiki.	Learner-Instructor
7	The instructor frequently asked the students questions related to wiki assignment.	Learner-Instructor
8	The instructor frequently attempted to elicit student interaction in wiki.	Learner-Instructor
9	Interaction between the instructor and the class was high in wiki.	Learner-Instructor
10	Discussions were more difficult to participate in wiki than other online learning tools I have used.	Learner-Learner
11	The students rarely asked each other questions regarding wiki.	Learner-Learner
12	Student-student interaction in wiki was more difficult than in other online learning tools I have used.	Learner-Learner
13	There was little interaction between students in wiki.	Learner-Learner
14	In wiki, I learned more from my fellow students than in other online learning tools I have used.	Learner-Learner
15	I felt I had adequate opportunities to participate in the wiki.	Learner-Learner
16	In wiki, students seldom stated their opinions to each other.	Learner-Learner
17	Students rarely answered each other's questions regarding wiki.	Learner-Learner
18	I worked on assignments with other students in wiki.	Learner-Learner
19	I told the instructor when I had a complaint or suggestion about wiki.	Learner-Instructor
20	I asked for clarification when I didn't understand something in wiki.	Learner-Instructor
21	I actively participated in scheduled meetings regarding wiki assignments.	Learner-Learner
22	I felt isolated from other students in wiki.	Learner-Learner
23	I felt isolated from the instructor in wiki.	Learner-Instructor
24	Support for helping me use wiki was available whenever I needed it.	Learner-Instructor

Table 3. Examples of Reflective Response and Corresponding Categories

Code	Examples
Time management	"We divided up the responsibilities for the synthesis part of the assignments, and settled on a time when we'd agree to have all of our input complete."
Task delegation	"My group met via MSN messenger during the week to discuss how we will tackle the Wiki assignments during the term."
Interacting with students	"My teammates and I determined together that we would have one person post the initial wiki activity and the other 2 team members would edit."
Interacting with instructor	"I requested my understanding be confirmed by the Professor and/or TA by initiating my understanding on Course Q&A."
Searching and reading information	"I did the required readings (text and articles) and researched the Wikipedia and other internet sites."
Learning to use PBworks	"I attended a webinar to learn about PBworks and shared the webinar information with my peers…"
Writing original postings	"I added to the page by speaking a little to the history of instructional technology and what types of e-learning we use on a regular basis."
Reviewing others' postings	"Continuously worked to improve our response."
Other	"Reflected on the last 7 weeks of class and the examples of the multi-media we have used."

Table 4. Coding Results of Reflective Responses

Week	Time Management	Task Delegation	Interacting with students	Interacting with instructor(s)	Searching and reading relevant information	Learning to use PBworks	Writing original postings	Reviewing others' postings	Other
1	No reading synthesis assignment								
2	2	5	8	2	9	5	12	11	1
3	2	3	12	0	14	0	13	11	1
4	1	3	7	0	15	0	12	7	0
5	1	2	4	0	13	0	11	7	0
6	0	2	3	0	10	0	8	5	0
7	0	1	5	0	9	0	9	5	2
8	0	4	5	0	8	0	8	8	4
9	1	1	5	0	9	0	8	4	2
10	No reading synthesis assignment								

Table 5. Paired sample t-Test Results on Interaction Levels Between Learner-Learner and Learner-Instructor

	Learner-Learner		Learner-Instructor		*t*	Sig.
	M	*SD*	*M*	*SD*		
Week 1	No reading synthesis assignment					
Week 2	4.67	1.09	4.14	0.79	2.73	0.015*
Week 3	4.80	0.99	3.70	1.04	4.21	0.00**
Week 4	5.01	0.77	3.13	0.75	6.74	0.00**
Week 5	4.61	0.63	2.87	0.83	7.35	0.00**
Week 6	4.79	0.77	2.95	0.93	5.79	0.00**
Week 7	4.56	0.71	2.74	0.99	7.89	0.00**
Week 8	4.51	0.80	2.93	0.95	5.63	0.00**
Week 9	4.32	0.59	2.93	0.99	5.73	0.00**
Week 10	No reading synthesis assignment					
Total	4.66	0.81	3.18	1.00	15.29	0.00**

*$p<.05$; **$p<.01$

Regarding reported activities of using PBworks, learners reported more interactions with their peers than did with the instructor. This finding corroborates the differences between Learner-Learner and Learner-Instructor interaction levels suggested by the statistical analysis. The number of reported activities, however, seems to be sensitive to the nature of weekly reading synthesis questions. For instance, in Week 3 students were asked to conduct comparisons between Cognitive Load Theory and the generic cognitive information processing theory, which is a high level of learning objective to achieve (Anderson & Krathwohl, 2001; Bloom, 1956). Consequently they reported the largest number of activities when compared to other weeks. With regards to task delegation, although it was not required by the course, participants spent most of the time in distributing workload and assigning tasks in the beginning of the course, not throughout the entire course. This implies that students did not switch task roles constantly during the eight-week course period in terms of contributing to the PBworks page due to efficiency consideration. The reflective response data suggested that participants rarely discussed issues related to time management (e.g., how he or she allocated their time in order to finish group assignments), which indicates their competency level in working in teams as they have accustomed to accomplish team projects from previous online courses. In terms of writing, reviewing, and editing contents on the wiki pages, participants tended to report them in the beginning of the course. This suggested that later in the course either the writing and reviewing processes were internalized thus participants did not explicitly describe them in the reflective survey, or learners did not always review, revise, and rewrite in wikis. The latter could be a potential drawback of using "semi-open" wikis in educational settings. Since semi-open wikis, constrained by the concern of students' privacy, are not accessible to everyone on the Internet, students are not motivated in constantly contributing and revising the wiki document (Lawler, 2008). Another possible explanation might be because learners feel fatigued because they think that writing on PBworks is an endless process. If they have to turn in a hard copy of the reading synthesis or respond to an online discussion thread, that often signifies the end of the assignment. On the wiki, however, because participants can go back to change the content of the page anytime, they might not perceive a tangible ending point of the assignment. As a result they could lose the momentum to continue their writing, reviewing, and editing processes at the end of the course period. Instructors therefore need to devise process guidelines to encourage students' regular participation in developing the wiki document.

In terms of the perceived interaction level when using PBworks, our naturalistic observation revealed a significant difference between perceived Learner-Learner and Learner-Instructor interaction level.

Participants apparently sensed more interaction with their peers than did with the instructor in the wiki. This finding might be contributed by two factors. First is the changing role of the instructor when teaching with wikis. Instructors' roles in learning environments afforded by emerging technologies, such as wikis, are shifting from "facilitators" to "equal partners" or "moderators" (Beldarrian, 2006; Cress & Kimmerle, 2008). Learners in wikis possibly no longer consider the instructor as an authoritative instructional figure because the learning process could be afforded entirely by interactions between learners and the wiki system (Cress & Kimmerle, 2008). Second, the nature of the weekly reading synthesis task did not prompt students to constantly seek for the instructor's feedback on the same topic. Once students finished one week's reading synthesis assignment, they moved on to an entirely different topic for the next week. On the other hand, if students were putting a comprehensive document together by following a stage-by-stage process (e.g., a grant proposal), students might perceive the interaction level with the instructor differently as the writing process requires the instructor's consistent feedback.

In considering the transactional interaction, as learners reported a higher level of interaction with their peers, it is possible that the instructor played a less role in facilitating the weekly reading synthesis assignments in the wiki. The dialogs between learners were more frequent than those between learners and the instructor. This finding might be due to the increased learners autonomy allowed in wikis. Because students had the full control of what to include in the reading syntheses and perceived a high degree of freedom to plan and implement the structure of their learning activities in the wiki. The design of the course assignments also needs to be considered when discussing wikis' impact on peer interactions. In this study the instructor only provided general guidelines for the reading synthesis assignments (i.e., topic, word limits) thus possibly encouraging the transactional interaction between learners. Assignments with rigid requirements might lower learners' motivations to interact with their peers in the wiki but learners might need to interact more frequently with the instructor. Although the dynamic association between transactional interactions and course structure is not unique in wikis, it is possible that utilities of wikis do provide more social and cognitive incentives for learners to interact with peer contributors than other online learning tools (e.g., discussion forums). Those features could possibly motivate learners to be more interactive in wikis with less regard for instructor-determined course structures.

Conclusions

The notion that wikis might enable collaborative learning between students (O'Shea, et al., 2007) was preliminarily confirmed in this study from the perspective of perceived interaction levels between peers. Reported activities further revealed how learners initiated and participated in collaborative writing activities in the wiki. The findings suggest that online instructors need to purposefully encourage and sustain learners' wiki activities (e.g., writing, reviewing, revising, and editing) throughout the learning process since learners might not be accustomed to wikis' consistent and dynamic collaborations. In the meantime online instructors should be sensitive of not taking away learners' freedom to be autonomous as it is vital to sustain learners' motivation to contribute in wikis. Future studies need to verify that Learner-Learner interaction in wikis might create a larger instructional impact than those between learners and instructors, to validate wikis' applicability to enhance online learning. Furthermore, existing theoretical frameworks for online teaching and learning need to be reexamined with features of Web 2.0 emerging technologies, to advance our understanding of online learning processes in this collaborative digital era and more importantly, to better help online learners achieve the intended learning outcomes.

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