Affordances and Constraints of a Wiki for Primary-school Students' Group Projects

Huijuan Fu[1*], Samuel Chu[1] and Wenxia Kang[2]
[1]Faculty of Education, The University of Hong Kong, Hong Kong // [2]Foreign Language Teaching and Research Press, Beijing, China // olinafu@hku.hk // samchu@hku.hk // conniekwx@gmail.com
*Corresponding author

(Submitted August 23, 2012; Revised November 28, 2012; Accepted February 27, 2012)

ABSTRACT

This study examined a wiki as a computer-supported collaborative learning (CSCL) environment at upper primary level. A total of 388 Hong Kong Primary-five (P5) students in four Chinese primary schools used a wiki platform within the context of their group projects in General Studies (GS) classes. Adopting a mixed-methods design, qualitative and quantitative data were collected from focus group interviews, survey and wiki entries. Findings showed that the wiki platform provided educational, technological, and social affordances for the P5 students' collaborative learning. At the same time, constraints were found to be related to technological factors and users' dispositions, which may be counterbalanced by providing scaffolding and selecting wiki variants. Students' attitudes towards the pedagogical value of the wiki were found to be strongly positive after the group project implementation. Overall, this research contributes to the literature on the use of wikis in primary education.

Keywords

Wiki, Affordances, Constraints, Collaborative learning, Primary school, Group project

Introduction

The potential of social software in facilitating positive changes in educational processes has been articulated. Wiki technology is one of the widely explored social software in schools, colleges and universities (Parker & Chao, 2007). Recent years have witnessed a rapid increase in the use of wikis as a computer-supported collaborative (CSCL) environment. CSCL emphasizes how technology can support collaborative learning to enhance members' interaction (Lipponen, 2002).

Research suggests that wiki technology is a useful tool for information sharing and knowledge construction (Chu, 2008; Elgort, Smith, & Toland, 2008). Research also shows that wiki technology helps improve the level of students' collaboration and their quality of work (Chu, 2008; Hughes & Narayan, 2009). However, a few studies have reported that the use of wikis has little impact on student's interaction, the problem of which has been identified as being associated with poorly supported integration of the wiki into the teaching format of a particular course (Cole, 2009). This suggests that the wiki, used as a CSCL environment needs to be examined in terms of not only technological capacities, but also the educational and social factors that facilitate collaborative activities (Kirschner, Strijbos, Kreijns, & Beers, 2004). Therefore, a better understanding of wikis in education will be developed if we examine the specific learning activities that are afforded by this technology.

Although the simplicity of wikis makes them a good tool for young learns in collaborative tasks, research regarding the use of wikis at primary level is scarce and in its infancy. Recent studies demonstrate that wikis is a useful tool for primary-school students' collaborative writing (Désilets & Paquet, 2005; Li, Chu, Ki, & Woo, 2012; Woo, Chu, Ho, & Li, 2011). However, there is limited information on the nature of the interaction between the students and the wiki (Elgort et al., 2008). Thus, this study aimed to present a systematic study of the affordances, constraints and students' attitudes towards a wiki for primary-school group projects.

Based on the objective, three specific research questions (RQ) were posed:

RQ1: What are the technological, educational and social affordances perceived by students when using a wiki for their group project work? And how do these affordances be utilized?

RQ2: What are the constraints perceived by students when using a wiki for their group project work? And how can these constraints be counterbalanced?

RQ3: What are the students' attitudes towards the pedagogical value of the wiki?

Literature review

Originally coined by Gibson (1977), the term "affordance" refers to a relation naturally existing between the attributes of an object and the characteristics of the user. It provides a direct approach to perceiving the value and meaning of objects or environments that afford users to perform particular actions. Norman defines this term as "the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used" (1988, p. 9). The difference between the two definitions is that Gibson's definition refers to utility, while Norman's refers to usability (Bower, 2008). As distinguished by Nielsen (1994), utility represents the functionality that a system provides a user, while usability concerns how well the user can actually use the functionality in order to achieving a task. Therefore, Gibson's perspective focuses upon the fundamental characteristics of the object in relation to the user, which is more suitable in discriminating how technologies can be applied to design learning tasks. Norman places more emphasis on how an object is perceived, which is a better way to evaluate learning technologies.

The concept of "affordance" is adopted in the field of CSCL as a framework for the purpose of designing and evaluating CSCL environments that involve the unanticipated interactions between members during collaborative learning, such that affordances are classified as educational, technological and social affordances (Kirschner et al., 2004). Educational affordance refers to characteristics of the learning environment that facilitate collaborative learning behavior; social affordance to characteristics that offer social-contextual facilitation in relation to students' social interaction; and technological affordance to characteristics that enable learners to accomplish learning tasks in an efficient and effective way. This classification is developed from the understanding that CSCL represents a learning situation "where the education context is collaborative, the social context is the group, and the technological context is the computer-mediated setting" (Kirschner et al., 2004, p. 50). When evacuating technology as a CSCL environment, we should analyze the combination of educational, social, and technological affordances for collaborative learning. In describing a methodology to support technology selection for the learning process, Bower (2008) puts forward a functional category of technological affordances. However, a classification of educational and social affordance has not been identified in previous studies. Studies must attempt to extend our understanding of affordances as they emerge from classroom practitioners' efforts to utilize this technology with a combination of these three elements.

To obtain a comprehensive characterization of the interactions between an object and its user, we need to explore the related concept of constraint, which refers to a boundary, guide, or structure for action (Kennewell, Tanner, Jones, & Beauchamp, 2008). A constraint is not a physical characteristic, but a perception of a potential for action that is dependent on a user's knowledge, skills and disposition. Constraint may sometimes be perceived as an obstacle to action. It has been defined as the incapacity, or diminished capacity, to utilize a tool at will (Murphy & Coffin, 2003). A delicate balance between affordances and constraints exists in any form of communication that is mediated by computer (Sherry, 2000). It has been suggested that an improved understanding of the affordances and constraints resulting from a user's interactions with learning environments is beneficial to teaching and learning (Swan, 2003).

Besides understanding the affordances and constraints of the wiki, it is also important to investigate primary students' attitudes of using the wiki for educational purposes. As applied to wikis, pedagogical value has been defined as the capacity of students to take part in learning through active participation in group interactions based on constructivist learning principles (Hazari & North, 2009). This evaluation approach generates learners' feedback that is specifically relevant to a technology efficacy in facilitating collaborative learning.

Conceptual framework

Theoretically, the use of wikis in CSCL is mostly grounded in constructivism (Larusson & Alterman, 2009; Parker & Chao, 2007). Constructivism is a theory of learning which asserts that learners can actively learn and construct rather than passively receive and store knowledge through their own inferences and discoveries based on their prior knowledge (Piaget, 1976; Vygotsky, 1978). Vygotsky states that learning is fundamentally social in nature, emphasizing the important role of social interaction and activity sharing in individuals' construction of knowledge and understanding (Cole & Wertsch, 1996). Based on social constructivist principles, collaborative interactions among students have been shown to enhance learning through exposure to alternative perspectives (Brett & Nagra, 2005). Collaborative learning also emphasizes social and intellectual engagement, and mutual responsibility (Smith

& MacGregor, 1992). As such, peer interactions that ensue from a collaborative approach represent an important component of the learning experience (Pascarella & Terenzini, 2005).

Since collaborative learning lays great stress on the extent of the exchanges that occur among students in a given environment (Dillenbourg & Schneider, 1995; Golub, 1998), the discussion that occurs during task engagement is an important consideration in a CSCL environment. It has been theoretically suggested, on the basis of their functionalities, that wikis can be used to promote collaborative learning (Augar, Raitman, & Zhou, 2004; Felder & Brent, 2003; Hsu, 2007).

Methodology

This study employed a mixed methods research design, using quantitative and qualitative data sources, to examine the usefulness of a wiki for P5 students' GS group projects.

Participants

The participants were 388 P5 students with an average age of ten years from four local primary schools.

Procedures

In a naturalistic setting, the P5 students were tasked to conduct group research projects during the 11-week period of the course (Seen in table 1). Students in groups of 5-6 worked on a GS project and each group chose a project topic under four themes proposed by the Curriculum Development Council (2011): (1) Life: Change, Change, Change, (2) Life in the city, (3) To know about my country, and (4) Beyond our earth. Google Sites was chosen as the wiki platform in this study because it does not require much setup, maintenance or technical knowledge, which makes it suitable for novice users (Herrick & Collins, 2009). In addition, Google Sites supports Chinese (Traditional) which is the mother language for the students.

Table 1. Timetable of the instructional design

Week	GS lesson	IT lesson	Library lesson
1		Students learned information and communication (ICT) skills, with a focus on the use of Google Sites.	
2			Students learned information literacy (IL) skills
3			
4	Students teamed up and made a plan for their group work.		
6-7	Information search and analysis		
8-11	Report construction on Google Sites		

This study adopted a collaborative teaching model that involved two kinds of subject teachers and the school librarian working together to implement the teaching objective. Such a teaching approach has been found to be beneficial in scaffolding students more effectively during the process of project completion (Chu, 2009). The roles of the different kinds of teachers are described as follows.

- The GS teachers focused on the subject aspect and research process of the projects - whether students were asking appropriate questions for the projects, classifying information found sensibly, and selecting suitable materials to be included in their project presentation. The GS teachers monitored students' work and commented on the wiki pages.
- The IT teachers were responsible for training students in the IT skills, focusing on the use of Google Sites. A project sample was provided on the first wiki page by the IT teachers (see Figure 1), and the groups were then free to start their pages to conduct their group work.
- The teacher librarian conducted activities to help equip students well with the information literacy skills that they would need to search, locate, and use relevant information sources for their projects.

Figure 1. Project sample-The History of Hong Kong

Data collection and analysis

Qualitative and quantitative data were collected alongside the implementation of the students' group projects in the GS course. Qualitative data sources included (1) focus group interviews (8 groups, 42 students: 9 students from KF, 5 students from CPS, 11 students from SH and 17 students from WSK); (2) students' reflections written on the wiki pages (12 groups: 3 groups from KF, 1 group from CPS, 4 groups from SH and 4 groups from WSK); and (3) students' activities on the wiki platform (12 groups as above). Focus group interviews were conducted at the end of the projects, in which open-ended questions probed students on their experiences in using Google Sites for project con-construction. Students were asked to write reflections about their experiences with the wiki pages, either individually or in groups. The wiki can record every revision, so we tracked students' contributions to the wiki pages (e.g., co-construction of reports and online communications).

The quantitative data source was a questionnaire-format instrument investigating students' perceptions of the pedagogical value of the wiki. For the qualitative data sources, one unit of analysis was defined as a transcription that corresponded to an action taken or a comment made by a student on a wiki page or recorded wiki revisions. Responses to open-ended questions in the group interviews were also transcribed and analyzed to reveal themes that appeared to illustrate affordance and constraints. The qualitative data sources were uploaded as text files into NVivo 8.0 software and coded based on the framework of affordances of CSCL environments. To determine the affordances, all qualitative data sources were coded using the framework of affordances of online learning environments as summarized in Table 2.

The first level categories of affordances included educational, technological and social affordances (Kirschner et al., 2004). Technological affordances are further defined in a second level of affordance categories: media, spatial, temporal, navigation, synthesis, and access-control (Bower, 2008). However, with regard to educational and social affordances, second level categories have not been identified in previous studies. As such, these emerged from the current data naturally through an interactive process of coding based on the definitions of affordances, identifying themes at the second level, and clarifying the definitions. Such an approach is a commonly employed strategy in cognitive studies (Chu, Chan, & Tiwari, 2001; Lee, Chan, & van Aalst, 2006). Preliminary coding was done by the authors in order to refine the second level of categories. Various iterations were discussed to clarify the definitions of categories. For inter-rater reliability, the first and third author independently coded 30% of data covering three sources in the first round, which resulted in 75% inter-rater agreement. After further discussion, all data were independently coded in the second round, which yielded 95% inter-rater agreement. In this study, five categories of educational affordances, and two categories of social affordances were found (See Table 2).

Table 2. Wiki affordance categories generated by the qualitative analysis

First Level Category	Second Level Category & Its Definition	Sample Contents & Its Source Number
Educational affordances	1. Group project management (Students are able to designate and schedule the assignment.)	*X and I work together every Thursday.* (A-SH-5B-3-C)*
	2. Group report co-construction (Students are able to participate in the document revision at will.)	*Google Sites is a collaborative environment, which allows us to do our work more conveniently. It is a platform for us to do our work and amend it together.* (I-SH-5B-K)
	3. Information sharing (Students are able to publish links to sources of.)	*Source: http://politics.people.com.cn/BIG5/8198/58705/index.html* (A-KF-5A-2-T)
	4. Knowledge sharing (Students are able to post their insights and interpretations on a concept or topic.)	*We can exchange opinions with each other in order to acquire more knowledge.* (I-KF-5B-A)
	5. Feedback sharing (Students are able to request and provide feedback between each other.)	*It would be better if you add more information about the consequence.* (A-SH-5B-4-Z)
Social affordances	1. Communication (Students can communicate online within a platform.)	*Google Sites is better as there is a chat box so we can chat with others while doing the project.* (I-SH-5A-B)
	2. Motivation (Students can enhance motivation among group members.)	*We see other groups' work that encourages us to work hard.* (R-SH-5B-4-W)
Technological affordances	1. Media (The ability to input and output various media forms, such as text, images audio and video)	*We can insert video and pictures into Google Site. We can use multi-media to present our work and then other students can understand our work more easily.* (I-CPS-5B-E)
	2. Spatial (The ability to resize, move or place contents within an interface)	*The contents are arranged in perfect order.* (A-SH-5B-4-T)
	3. Temporal (The ability to access anytime anywhere as well as to record and play back information)	*Google Sites allows us to do our work at home. We need not gather in front of one computer, or do it separately on our own computers using 'read-only'.* (I-SH-5B-J)
	4. Navigation (The ability to browse and search other sections of the interface, as well as to link and sort sections)	*The side-bars are very user-friendly. I can just click into any page that I want to see.* (I-WSK-5C-D)
	5. Synthesis (The ability to combine and integrate multiple components and create a mixed-media platform.	*I can synthesize other Google functions to create a better collaborative environment.* (I-GPS-5B-K)
	6. Access-control (The ability to allow or deny access and contributions)	*Google Sites allows multi-users to amend the documents.* (I-SH-5B-J)

Note. *The source number constitutes source type, school code, class number, group number and student code. (Source type: I for group interviews, R for students' reflections; and A for students' activities)

While the literature suggests that a balance between affordances and constraints is ideal in the use of technology, no structural framework has been found to examine constraints. Thus, to explore this, the iterative approach was again used to code the qualitative data units that referred to a boundary, guide, or structure for action (Kennewell et al., 2008) that may have resulted in decreased capacity to utilize a tool at will (Murphy & Coffin, 2003). The categories emerged from the data naturally and were summarized in Table 3.

Table 3. Wiki constraint categories generated by the qualitative analysis

Category	Definition	Sample Contents &Its Source Number
Lower familiarity	Distinction from traditional technology format, such as MS office, email, and telephone	*Compared to wiki, I can work faster with word processing software because I use it frequently before.* (I-CPS-5B-F)
Wiki formatting system	The distinct formatting rules that students find problematic in the co-construction of materials.	*Sometimes the format view under "edit" and "view" pages appear differently.* (I-WSK-5B-B)
Internet dependence	The inability to contribute work without internet access	*I have to re-do my work due to internet connection problem.* (I-SH-5A-K)

Note. *The source number constitutes source type, school code, class number, group number and student code.
(Source type: I for group interviews, R for students' reflections; and A for students' activities)

An instrument to assess students' perceptions of the pedagogical value of wiki technology (Hazari & North, 2009) was used. The standard for instrument reliability for Cronbach's alpha by Robinson, Shaver, and Wrightsman (1991) was used to evaluate the quality of the scales of the attitude measures. The standards were: 0.80 or better – exemplary reliability; 0.70-0.79 – extensive reliability; 0.60-0.69 – moderate reliability; and <0.60 – minimal reliability. This instrument measured the following constructs: overall learning, motivation, group interaction, and technology (Hazari & North, 2009). Responses from all four schools were analyzed quantitatively as a whole and focus group interviews were also analyzed to document the findings further. There were five items per construct, and a Chinese version of the instrument was given to avoid language misunderstanding. A 5-point Likert type scale was used: 0 representing "I don't know", 1 representing "Strongly disagree", 2 representing "Disagree", 3 representing "Neutral", 4 representing "Agree" to 5 representing "Strongly agree". Statistical tests were done using SPSS 16.0.

Findings and discussion

Affordances

A total of 549 references to affordances were found: 79 from students' responses to open-ended questions in interviews, 63 from students' reflections on the wiki pages, and 407 from the wiki recorded students' activities on the wiki platform. The number of coded references and their percentage distribution in all three major categories are summarized in Table 4.

A synthesis of the findings from the different data sources showed that technological affordances were most apparent, followed by educational affordances and social affordances. First of all, for students' responses in group interviews, the most prominently reported affordances were related to technological aspects. Specifically, temporal affordance was mostly reported. With respect to educational affordances, the analysis revealed that the wiki allowed group report co-construction with simultaneous contributions for collaborative work and provided a platform to share information, knowledge and comments. The wiki was also found to provide a social affordance by serving as a platform for communication and motivation. Secondly, in terms of students' reflections posted on the wiki pages, educational affordances were found to be the most prominent (73%). The top education affordance was that the wiki provided students with a platform to co-construct their group reports (36.5%). There were a small percentage of technological affordances. References coded to social affordances were distributed between communication and motivation. Lastly, most of the references from students' activities were centered on the technological aspects, and more than half of the coded references were media affordances.

The usefulness of a CSCL environment consists of its usability and utility, is determined by the various types of affordances (Kirschner et al., 2004). Usability, which is the extent to which the CSCL environment is used by students in supporting their collaborative group work, is determined by technological affordances (Vatrapu, Suthers, & Medina, 2008). Our findings provided evidence that supported the usability of wikis as a CSCL environment. The observation of students' online activities highlighted the technological affordances. Consistently, throughout all sources of data, media affordance was found to be the most prevalent. This is not surprising since the primary function offered by wikis is the ability to combine reading and writing within a web browser, and the wiki allows several users to create and link web pages simultaneously (Lamb, 2004). Temporal affordance was reported most during the interviews. For example, one student (I-SH-5B-F) reported, "*We can share with each other at anytime and*

anywhere. We need not to write it down, or go to others' homes". This showed that students enjoyed this learning experience mostly because they were able to carry out the project at their convenience. The synthesis affordance is an important aspect of the wiki as a technological support for collaborative learning, but it was less prominent in this study. This may be because primary-school students have low "combine-ability" and "integrate-ability".

Table 4. Wiki affordances found in different data resource

Affordance	Number of coded references (%)			
	Interview	Reflection	Activities	Sub-total
Educational				
1. Group project management	1 (1.3%)*	8 (12.7%)	11 (2.7%)	20 (3.7%)
2. Group report co-construction	6 (7.6%)	23 (36.5%)	26 (6.4%)	55 (10%)
3. Information sharing	2 (2.5%)	0 (%)	32 (7.9%)	34 (6.2%)
4. Knowledge sharing	1 (1.3%)	8 (12.7%)	17 (4.2%)	26 (4.7%)
5. Feedback sharing	6 (7.6%)	7 (11.1%)	27(6.6%)	40 (7.3%)
Sub-total	***16 (20.3%)***	***46(73%)***	***113 (27.8%)***	**175 (31.9%)**
Social				
1.Communciation	19 (24%)	2 (3.2%)	15 (3.7%)	36 (6.6%)
2. Motivation	1(1.3%)	5 (7.9%)	7 (1.7%)	13 (2.3%)
Sub-total	***20 (25.3%)***	***7(11.1%)***	***22 (5.4%)***	**49 (8.9%)**
Technological				
1. Media	8 (10.1%)	5 (7.9%)	251 (61.7%)	264 (48.1%)
2. Spatial	2 (2.5%)	2 (3.2%)	14 (3.4%)	18 (3.3%)
3. Temporal	23 (29.1%)	0 (0%)	0 (0%)	23 (4.2%)
4. Navigation	4 (5.1%)	2 (3.2%)	3 (0.7%)	9 (1.6%)
5. Synthesis	1 (1.3%)	0 (1.6%)	2 (0.5%)	3 (0.5%)
6. Access control	5(6.3%)	1 (0%)	2 (0.5%)	8 (1.5%)
Sub-total	***43 (54.4%)***	***10(15.9)***	***272 (66.8%)***	**325 (59.2%)**
Total	***79 (100%)***	***63(100%)***	***407 (100%)***	**549 (100%)**

Note. * percentage is calculated within each data source

Utility is determined by the combination of educational and social affordances (Kirschner et al., 2004), and these two dimensions have been proposed as the core educational affordances in designing CSCL environments (Bower, 2008). This current study corroborates earlier findings showing that wikis have been useful for similar purposes of group project management and report construction through questionnaire-based feedback (Chu & Kennedy, 2011). The wiki is able to provide these educational affordances because it provided group members with a platform to engage in several iterations of project plans and report construction. This appears to be related to the technological affordance, but we propose that educational affordances are achieved when the technological aspect is supported by pedagogical factors. It has been suggested that educational affordances are related to the characteristics of a learning program (Kirschner et al., 2004). In the contest of the learning activity in this study, the students were given course instructions that prepared them to use the wiki for planning and managing their group projects. They were also required to build their own group report on the wiki, instead of using other traditional forms of word processing technology. With such course-specific learning conditions, the affordances were not limited to the technological dimension.

Social affordances were relatively less pervasive in the findings of this study. This dimension was found to be generally centered on the provision of a communication platform. Kreijins, Kirschner and Jochems (2002) have emphasized that social affordance technologies must be able to support or anticipate users' social intentions. A social affordance technology will facilitate a group member's initiation of a communication episode with other members who have been perceived to be present. These characteristics were found to be present in the wiki that was used in this study, as evident in the exchange of comments on the wiki pages. During observed activities, students were also found to respond to comments. When seeing "*you could think more about why Miao males have such habits of dressing*", students immediately responded "*thanks for your questions, we are looking for answers*". Furthermore, one students (I-SH-5B-J) reported "*Google Sites is better as there is a chatbox so we can chat with others at our own homes instead of having to meet out*", confirming that the students utilized the wiki platform as a means of engaging in communication.

Constraints

Table 5 summarized the constraints that were identified from the coded references from different data sources. Constraints were mostly revealed by the students' responses in the group interviews, with 40 coded references. The most often reported constraint was related to the wiki formatting system (45%), followed by the distinction between the wiki and more familiar forms of technology (25%). For students' activities with Google Sites, 16 references were coded. Only two constraints were found, lower familiarity (37.5%) and the wiki formatting and technical system (63.5%). Few references were coded from students' reflections on the wiki pages.

The wiki's formatting system was found to be an obstacle to building wiki pages efficiently. The users encountered difficulties in achieving the desired organization and appearance of their wiki pages, and they generally attributed this to the formatting system of the wiki. As such, it might be considered that the degree of constraint associated with wiki's formatting system might differ according to the distinct wiki variants that are freely available (e.g. Media Wiki, PB Works, TWiki).

Table 5. Wiki constraints found in different data resource

Constraints	Number of coded references (%)		
	Interview	Activities	Reflection
1. Lower familiarity	12 (30%)	6 (37.5%)	2 (40%)
2. wiki formatting system	18 (45%)	10 (63.5%)	3 (60%)
3. Internet dependence	8 (20%)	0 (0%)	0 (%)
Total	40 (100%)	16 (100%)	5 (100%)

Note. *percentage distribution is within each data source

In this case, our findings showed that the distinction between the wiki and traditional forms of technology was a constraint because of the users' relatively greater familiarity with the latter. Fortunately, students were found to adopt not a passive but an active attitude towards constraints. Student (1-SH-5A-D), for example, said, *"I would choose Google Sites as it allows us to use a more difficult tool to do projects that can train our brain"*. When students were asked how they addressed the problem, two students reported that they read the instructional manual, while others sought help from teachers and peers. This highlights the fact that constraints are not necessarily negative attributes, but can be perceived as obstacles to the effective use of functions (Murphy & Coffin, 2003) that may enhance students' learning. On the other hand, it implies that extra training sessions could be scheduled, after students have been conducting their projects for 2-3 weeks, in which instructors can ask the students to demonstrate different tasks on the wiki to increase students' familiarity with the tool. Subject teachers are expected to have sufficient knowledge about wikis in order to assist students in the whole process.

Additionally, the dependence of the wiki system on internet access was also a constraint. While dependence on an internet connection might be related to the temporal technological affordance that allows simultaneous contributions, students reported problems of lost page revisions which were thought to have been saved. Google Sites manages conflict handing by page locking, which results in having only one user allowed to edit the pages at a particular time. Other systems like MediaWiki, which is the system used by Wikipedia, manages conflict handing by SVN merging (MediaWiki, 2012).

Students' attitudes

All 388 participating students were invited to fill in the self-administered survey. But the sample sizes for the different items varied, because some students did not respond to some of the statements. The mid-point of the rating scale is 3 (Moderate). Hence, any rating that was larger than 3.00 would be considered as edging towards positive perception and vice versa. Table 6 showed the quantitative analysis of the students' ratings.

Table 6. Descriptive Statistics of Wiki perceptual survey

Construct	Question Items	M (SD)	Median	Cronbach's alpha
Overall learning	Q5. Use of the wiki aided me in achieving the course objectives.	3.71 (1.294)	4.00	.870***

	Q7. I would like to see wikis being used in other courses.	3.71 (1.224)	4.00	
	Q9. I participated in the assignment more because of using the wiki.	3.54 (1.245)	4.00	
	Q14. I will retain more material as a result of using the wiki.	3.59 (1.341)	4.00	
	Q19. The use of wiki enhanced my interest in the course.	3.58 (1.360)	4.00	
Motivation	Q3. I would prefer projects that use a wiki over other projects that do not use a wiki.	3.58 (1.357)	4.00	
	Q6. I stayed on the task more because of using the wiki	3.58 (1.289)	4.00	
	Q8. The benefits of using a wiki are worth the extra effort and time required to learn it.	3.49 (1.247)	4.00	.863***
	Q15. I would recommend classes that use wikis to other students.	3.55 (1.361)	4.00	
	Q20. I will continue to explore use of a wiki for project work.	3.65(1.414)	4.00	
Group Interaction	Q2. I like seeing other students' interaction with material I posted in the wiki.	3.40 (1.311)	3.00	
	Q11. Use of the wiki for the assignment helped me interact more with other students.	3.52 (1.266)	4.00	
	Q13. Because of using the wiki, my group was able to come to a consensus faster.	3.46 (1.285)	4.00	.864***
	Q17. Use of the wiki promoted collaborative learning	3.57 (1.300)	4.00	
	Q18. I learned more because of information posted by other students' in the wiki.	3.50 (1.285)	4.00	
Technology	Q1. The wiki interface and features were overall easy to understand.	3.78 (1.228)	3.00	
	Q4. Browsing/editing information in the wiki was easy.	3.69 (1.302)	4.00	
	Q10. Benefits of using the wiki outweighed any technical challenges of its use.	3.36 (1.361)	4.00	.848***
	Q12. Technical features in the wiki helped enhance my learning.	3.59 (1.341)	4.00	
	Q16. Compared to other online discussion boards, the wiki was easier to use.	3.47 (1.352)	4.00	

Note. ***0.80 or better – exemplary reliability

This scale exhibited extensive reliability, and we were able to analyze four subscales. The averages of the students' ratings on all of the 20 statements were above 3.0, indicating that students were positive about the influence of the wiki on their experiences. This result is consistent with the findings of earlier studies that primary-school students are positive about using a wiki for collaborative tasks (Li et al., 2012; Woo et al., 2011).

- *Overall learning*. The ratings of the five components contributing to this factor indicated that students generally perceived the wiki as an effective tool to foster learning. Students' learning interests were shown to be enhanced with the use of the wiki. One student (I-SH-5B-J) reported that he had "*little interest [in the beginning] but after doing this project, [he] feel[s] like more funny and interesting and want[s] to learn more*." The new learning approach also reinforced students' knowledge acquisition by providing them with opportunities to learn from experiences which are meaningful and significant to them (Dewey, 1916). Another student (R-WSK-5A-L) wrote, "*After this project, I learnt that the harm of solar storm is closely related to us*".

- *Motivation.* One of the anticipated challenges of implementing a wiki system with P5 students was the steep learning curve caused by the technical constraints, which could have suppressed students' enthusiasm in making use of the new technology for their projects. However, students held positive opinion on the wiki as they

generally agreed that the benefits associated with the wiki outpaced the extra time and effort needed to learn about it. According to the students' reflections, it found that they "*cherished this opportunity and expected more group work with a wiki"*.

- *Group Interaction*. Communication among group members was enhanced and consensus was reached more efficiently owing to the use of the wiki. Students generally showed enthusiasm in group collaboration on the wiki. The students' ratings and discussion responses demonstrated generally positive attitudes of students towards peers' contribution to their project via wiki technology. One of the students (I-KF-C) reported "*Google Sites allows other people to comment on our work and we can learn more from that"*.

- *Technology*. Notwithstanding the potential technical difficulties that they might encounter, the students perceived the impact of the technology on their learning to be positive. Students reported that the functions of wiki technology were user-friendly and helpful. For example, when compared to the more traditional ways of completing a group project, one student (I-KF-A) commented that "*[Google Sites] all group members can do the group project at the same time, unlike Microsoft Word, [which] is simpler and easier to manage*. Another student (I-SH-F) reported that "*[We] can share with each other at anytime and anywhere. We need not to write it down, or go to others' home.*

Conclusion and implications

This study evaluated the use of a wiki as a CSCL environment in terms of affordances and constraints, as well as students' perceptions. Using a combination of qualitative and quantitative data sources, we demonstrated that a wiki was a useful platform that supports collaborative learning. Usability was supported by technological affordances that centered on the ability to build and perceive mixed-media wiki pages. Utility was substantiated by educational affordances that were related to group project management and group report co-construction, as well as by social affordances that focused on the ability of group members to communicate with one another.

The study also identified constraints that were related either to the characteristics of the wiki technology itself or to users' disposition. These findings offer relevant insights for educators' decision-making when using wikis in their classrooms. They suggest that when choosing a wiki variant as a learning environment, educators may need to take into account a formatting system that is suited to the intuitive tendencies of users. Furthermore, pedagogical instruction must account for users' personal dispositions to facilitate the affordances and manage the constraints.

Finally, this study suggests that primary-school students tend to have positive attitudes of the wiki for collaborative project learning. Future studies can examine and compare the perceived effectiveness and user experience of different wiki variants in facilitating primary-school students' group project work that may offer more sufficient advice for educators to select a suitable wiki variant. Furthermore, students' interactions with a wiki platform during different phases of their learning process could be further explored in order to expand our understanding of wiki-supported collaborative learning instruction.

Acknowledgements

Research reported in this paper was supported by Quality Education Fund titled "Promoting a collaborative teaching approach to inquiry project-based learning with Web 2.0 at upper primary levels."

References

Augar, N., Raitman, R., & Zhou, W. L. (2004). From E-Learning to virtual learning community: Bridging the gap. In W. Liu, Y. Shi, & Q. Li (Eds.), *Advances in Web-Based Learning - ICWL2004* (pp. 301-308). Verlag Berlin, Germany: Springer.

Bower, M. (2008). Affordance analysis--matching learning tasks with learning technologies. *Educational Media International, 45*(1), 3-15.

Brett, P., & Nagra, J. (2005). An investigation into students' use of a computer-based social learning space: Lessons for facilitating collaborative approaches to learning. *British Journal of Educational Technology, 36*(2), 281–292.

Chu, S. K. W. (2008). TWiki for knowledge building and management. *Online Information Review, 32*(6), 745-758.

Chu, S. K. W. (2009). Inquiry project-based learning with a partnership of three types of teachers and the school librarian. *American Society for Information Science and Technology, 60*(8), 1671-1686.

Chu, S. K. W., Chan, C. K. K., & Tiwari, A. F. Y. (2001). Using blogs to support learning during internship. *Computers & Education, 58*(3), 989-1000.

Chu, S. K. W., & Kennedy, D. M. (2011). Using online collaborative tools for groups to co-construct knowledge. *Online Information Review, 35*(4), 581-597.

Cole, M. (2009). Using Wiki technology to support student engagement: Lessons from the trenches. *Computers & Education, 52*(1), 141-146.

Cole, M., & Wertsch, J. V. (1996). Beyond the individual-social antinomy in discussions of Piaget and Vygotsky. *Human development, 39*, 250-256.

Désilets, A., & Paquet, S. (2005). Wiki as a tool for web-based collaborative story telling in primary school: A case study. In P. Kommers & G. Richards (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2005* (pp. 770-777). Chesapeake, VA: AACE.

Dewey, J. (1916). *How we think*. Boston, MA: Houghton Mifflin Company.

Dillenbourg, P., & Schneider, D. (1995). Collaborative learning and the Internet. Retrieved Feb. 2, 2012, from http://tecfa.unige.ch/tecfa/research/CMC/colla/iccai95_1.html

Elgort, I., Smith, A. G., & Toland, J. (2008). Is wiki an effective platform for group course work? *Australasian Journal of Educational Technology, 24*(2), 195-210.

Felder, R., & Brent, R. (2003). Learning by doing. *Chemical Engineering Education, 37*(4), 282–283.

Gibson, J. J. (1977). The theory of affordances. In R. Shaw & J. Bransford (Eds.), *Perceiving, Acting and Knowing* (pp. 67-82). Hillsdale, NJ: Lawrence Erlbaum.

Golub, J. (1998). *Focus on collaborative learning*. Urbana, IL: National Council of Teachers of English.

Hazari, S., & North, A. (2009). Investigating pedagogical value of wiki technology. *Information Science, 20*(2), 187-198.

Herrick, D. R., & Collins, F. (2009). Google this!: Using Google apps for collaboration and productivity. *Proceedings of the ACM SIGUCCS fall conference on User services conference (pp.55-64)*. New York, USA: ACM. doi: 10.1145/1629501.1629513

Hsu, J. (2007). Innovative technologies for education and learning: Education and knowledge-oriented applications of blogs, wikis, podcasts, and more. *International Journal of Information and Communication Technology Education, 3*(3), 70-88.

Hughes, J. E., & Narayan, R. (2009). Collaboration and learning with wikis in post-secondary classrooms. *Interactive Online Learning, 1*, 63-82.

Kennewell, S., Tanner, H., Jones, S., & Beauchamp, G. (2008). Analysing the use of interactive technology to implement interactive teaching. *Computer Assisted Learning, 24*(1), 61-73.

Kirschner, P., Strijbos, J. W., Kreijns, K., & Beers, P. J. (2004). Designing electronic collaborative learning environments. *Educational Technology Research and Development, 52*(3), 47-66.

Kreijins, K., Kirschner, P. A., & Jochems, W. (2002). The sociability of computer-supported collaborative learning environments. *Educational Technology & Society, 5*(1), 8-22.

Lamb, B. (2004). Wide open spaces: Wikis, ready or not. *Educause Review, 39*(5), 36-48.

Larusson, J. A., & Alterman, R. (2009). Wikis to support the "collaborative" part of collaborative learning. *International Journal of Computer-Supported Collaborative Learning, 4*(4), 371-402.

Lee, E. Y. C., Chan, C. K. K., & van Aalst, J. (2006). Students assessing their own collaborative knowledge building. *International Journal of Computer-Supported Collaborative Learning, 1*(1), 57-87.

Li, X. X., Chu, S., Ki, W. W., & Woo, M. (2012). Using a wiki-based collaborative process writing pedagogy to facilitate collaborative writing among Chinese primary school students. *Australasian Journal of Educational Technology, 28*(1), 159-181.

Lipponen, L. (2002). Exploring foundations for computer-supported collaborative learning. In G. Stahl (Ed.), *Proceedings of the Computer-Supported Collaborative Learning 2002 Conference* (pp. 72–81). Mahwah, NJ: Erlbaum.

MediaWiki. (2012). Quick SVN merging guide Retrieved Sep. 25, 2012, from http://www.mediawiki.org/wiki/Quick_SVN_merging_guide

Murphy, E., & Coffin, G. (2003). Synchronous communication in a web-based senior high school course: Maximizing affordances and minimizing constraints of the tool. *American Journal of Distance Education, 17*(4), 235-246.

Nielsen, J. (1994). *Usability engineering*. San Francisco, CA: Morgan Kaufmann Publishers.

Norman, D. A. (1988). *The psychology of everyday things*. New York, NY: Basic Books.

Parker, K. R., & Chao, J. T. (2007). Wiki as a teaching tool. *Interdisciplinary Journal of Knowledge and Learning Objects, 3*, 57-70.

Pascarella, E. T., & Terenzini, P. T. (2005). *How college affects students: A third decade of research* (Vol 2). San Francisco, CA: Jossey-Bass.

Piaget, J. (1976). *The grasp of consciousness: Action and concept in the young child*. Cambridge, MA: Harvard University Press.

Robinson, J. P., Shaver, P. R., & Wrightsman, L. S. (1991). *Measures of personality and social psychological attitudes*. San Diego, CA: Academic Press.

Sherry, L. (2000). The nature and purpose of online conversations: A brief synthesis of current research. *International Journal of Educational Telecommunications, 6*(1), 19-52.

Smith, B. L., & MacGregor, J. T. (1992). What is collaborative learning. In A. S. Goodsell, M. R. Maher & V. Tinto (Eds.), *Collaborative Learning: A Sourcebook for Higher Education* (pp. 10-29). University Park, PA: National Center on Postsecondary Teaching.

Swan, K. (2003). Learning effectiveness: What the research tells us. In J. Bourne & J. C. Moore (Eds.), *Elements of Quality Online Education, Practice and Direction* (pp. 13-45). Needham, MA: Sloan Center for Online Education.

The Curriculum Development Council. (2011). General Studies for primary schools curriculum guides (Primary 1- Primary 6) Retrieved from http://www.edb.gov.hk/attachment/en/curriculum-development/kla/general-studies-for-primary/gs_p_guide-eng_300dpi-final%20version.pdf

Vatrapu, R., Suthers, D. D., & Medina, R. (2008). Usability, sociability, and learnability: A CSCL design evaluation framework. *Proceedings of the 16th International Conference on Computers in Education* (pp. 369–373). http://www.apsce.net/icce2008/papers/ICCE2008-paper242.pdf

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Woo, M., Chu, S., Ho, A., & Li, X. X. (2011). Using a wiki to scaffold primary school students' collaborative writing. *Educational Technology & Society, 14*(1), 43-54.