



<b>Title</b>	<b>Inquiry project-based learning with wiki at Primary Five level</b>
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<b>Citation</b>	<b>The 2011 Research Symposium of the Center for Information Technology in Education (CITERS 2011), The University of Hong Kong, Hong Kong, 30 June 2011.</b>
<b>Issued Date</b>	<b>2011</b>
<b>URL</b>	<b><a href="http://hdl.handle.net/10722/161208">http://hdl.handle.net/10722/161208</a></b>
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Cited as: Chu, S.K.W., Wong, K., Lee, C., Chow, K. & Ng, J. (2011). Inquiry project-based learning with wiki at Primary Five level. Paper presented at CITE Research Symposium 2011, The University of Hong Kong, Hong Kong.

## Inquiry project-based learning with wiki at Primary Five level

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### ABSTRACT

Inquiry project-based learning (inquiry PjBL) has been regarded as an innovative educational approach among local primary schools in Hong Kong, replacing gradually the more traditional didactic teaching approach. Many studies have been conducted to investigate the effectiveness of inquiry PjBL in equipping students with skills needed by the 21<sup>st</sup> century. However, the lack of an effective delivery method hinders its widespread implementation. This study examined the suitability of using wiki, a form of Web 2.0 technologies, as a platform for the implementation of inquiry PjBL among Primary Five students in Hong Kong. Four schools were recruited and students (n=420) were given an inquiry group project to work on, using Google Sites as an online collaborative platform. The outcomes were evaluated using an online survey designed to assess the effectiveness of wiki in four domains: learning/pedagogy, motivation, group interaction, and technology. Focused group interviews were also conducted to obtain students' insights regarding the learning experiences. The study found that the use of a wiki in supporting inquiry PjBL was perceived positively by students. Students found the learning experience enjoyable and the various functionality of the wiki enhanced their acquisition of knowledge and skills. Findings of this study may help provide practical suggestions to education practitioners to incorporate wiki into inquiry PjBL and help demonstrate the potential of wiki in facilitating the development of knowledge and skills among students.

*Keywords: inquiry project-based learning, Web 2.0, wiki, survey*

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### Introduction

As the global structure is changing rapidly in the 21<sup>st</sup> century, the needs and demands for the societies are different. In Hong Kong, the economy has shifted swiftly to knowledge-based economy with which people are assigned tasks requiring a higher degree of problem-solving and communication skills, as more routine work has been taken up by technology. To address this,

educators have continued to modify their teaching strategies and goals in order to better equip their students with the skills demanded by the society. Inquiry project-based learning (inquiry PjBL), which combines inquiry-based learning (IBL) and project-based learning (PjBL), has been regarded as an innovative pedagogical approach (Helle et al., 2006). A considerable amount of research has collectively reported of the greater effectiveness of inquiry PjBL over the more traditional rote learning (Guthrie et al., 2004; Hickey et al., 2000; Hickey et al. 1999; Hmelo-Silver et al., 2007; Langer, 2001; Lynch et al., 2005; Wu & Tsai, 2005). Despite its increasing popularity amongst education practitioners and researchers, the proper and effective implementation of inquiry PjBL is still yet to be discussed explicitly (Crawford, 1999). This study proposes the use of wiki, a Web 2.0 technology, as a facilitating tool for the implementation of inquiry PjBL under Hong Kong primary education. The study used a case study approach to explore the influences that a wiki may bring to students as they engage in a General Studies (GS) inquiry group project. The findings of the study may illustrate the potential that Web 2.0 technologies, especially wikis, can bring to influence the learning experience of primary students.

### **Literature Review**

In the 21<sup>st</sup> century, globalization has shaped business organizations across the world to become more knowledge-intensive, mobile across space, and collaborative in nature (Dunning, 2000). Hong Kong, in particular, is shifting swiftly to a knowledge-based economy faster and farther than any other country in the world (Enright, 2000). The rapid technological advancement has influenced significantly the expectations on the labor force as routine work has been taken up gradually by technologies and people are assigned to jobs that demand expert thinking and complex communications (Levy & Murname, 2004). Consequently, students are expected to develop higher degree of problem-solving and collaboration skills to cope with the new tasks assigned to people, such as research and development, design, marketing and sales, and global supply chain management (NCEE, 2007).

To address the changes, the Education Bureau of Hong Kong has carried out a series of curricular reforms in order to incorporate inquiry-based learning (IBL), a student-centered teaching and learning approach, as a way to promote the integration of skills, knowledge and learning values (EDB, 2002). IBL is one of the most discussed pedagogies amongst constructivist educators in which teachers assume the role of facilitators who arouse students' learning interest with thought-provoking questions (Harada & Yoshina, 2004). As self-generated tasks are emphasized (Harada & Yoshina, 2004), students who engage in IBL possess stronger sense of ownership to their works (Gross, 1999). With IBL, students were found to show improvement in their research skills, subject knowledge as well as reading and writing abilities (Chu et al., 2007; Chu et al., 2008; Frank et al., 2003).

Along with IBL, the EDB of Hong Kong is in support of "student-centered learning strategies" (EDB, 2011, p. 70), which promote group projects as an additional element to traditional

classroom teaching. Project-based learning (PjBL) is a pedagogical approach which engages students in an investigative project (Blumenfeld et al., 1991; David, 2008; Marx et al., 1997; Thomas, 2000). Teachers guide students in carrying out an open-ended project which encourages their active engagement in information gathering and analysis (Prince & Felder, 2006). Students are scaffolded to research into their interested areas and consequently they develop a greater sense of responsibility towards their learning (Alloway et al., 1996).

Inquiry project-based learning (inquiry PjBL) is an innovative teaching approach resulted from the combination of IBL and PjBL. Traditional modes of teaching subscribes to the idea that teachers should dictate the pace and scope of education (Chu, 2009), thus reducing students' sense of autonomy. Another pitfall of the more traditional didactic teaching approach is that it can lead to rote memorization and surface learning (Helle, et al., 2006). Inquiry PjBL, on the contrary, fosters students' independent learning by allowing them to work at their own pace towards the completion of the task (Woo et al., 2011). This enriches students' learning experience and allows them to develop into more self-directed learners (Chu, 2009).

Students' development on problem-solving skills is emphasized in inquiry PjBL (Chu, 2009; Helle et al., 2006). Under the guidance of a more skilled person, e.g., teachers or school librarian, students are encouraged to apply their learnt knowledge and skills into the project when problems are encountered (Helle et al., 2006; Oliver, 2001; Owens, 2002). Some researchers argue that inquiry PjBL has long-term effects that persist after the project completion such as the adoption of a more adaptive learning attitude and the ability to deal with problems, termed progressive problem-solving (Bereiter & Scardamalia, 1996).

Inquiry PjBL involves the construction of an artifact, such as written reports, as one of the learning outcomes, which differentiates it from IBL (Helle, et al., 2006; Oliver, 2001). This promotes students' abilities to synthesize and integrate ideas into a well-informed and systematically structured end-product. Compared to IBL, inquiry PjBL lessens the possibility of over-looking information and skills as careful investigation into matters and application of skills are deemed essential for the successful creation of the product. The process of output completion requires continuous negotiations and discussions among all involved parties, hence the communication among students, teachers and school librarian is enhanced (Askeland, 1999; Woo, et al., 2011).

Despite its numerous advantages, students and teachers still encounter obstacles in the actual implementation of inquiry PjBL. The main barrier is about determining an effective and practical delivery method (Woo, et al., 2011). Front-line teachers often demonstrate resistance to new teaching approaches even they are shown to be effective (Crawford, 1999). For inquiry PjBL, this is most probably due to the added workload as well as the lack of school resources supporting the adoption of the new pedagogy (Chu, 2009).

To facilitate teaching and learning, Web 2.0 technologies (e.g., blogs and wikis) have been brought into classrooms (Chu, et al., 2012; Chu, et al., in press; Chu & Kennedy, 2011; Richardson, 2006). In contrast to Web 1.0 which is characterized by a passive presentation of content, Web 2.0 promotes active participation among its users by allowing them to contribute to the content (Chu, 2008; Chu, 2011; Kennedy, 2007). Wiki, for instance, is a popular form of Web 2.0 technology which enables its users to “add content and ... edit content that has already been published” (Richardson, 2006, p.8). A wide range of research has shown the application of wiki in educational setting to be beneficial (Chu, 2008; Fung et al., 2011; Law et al., 2011; Li et al., 2012; Mak & Coniam, 2008; Pifarre & Starrman, 2011; Tavares & Chu, 2011). Potential benefits include the facilitation of students’ development on critical thinking and problem-solving skills (Woo et al., 2011), improvement in collaboration and hence work quality (Chu, 2008), and enhancement of social skills (Fung et al., 2011).

## **Research Gap**

Although many studies have been done to investigate the effectiveness of inquiry PjBL in facilitating teaching and learning, the research on scaffolding the implementation of the pedagogy with Web 2.0 technologies is scarce. To cope with the potential difficulties encountered by students and educators with regard to the carrying out of inquiry PjBL, this study intends to investigate the effectiveness of wiki as a platform to deliver the teaching approach under local primary education settings.

## **Methodology**

To explore how wiki technology influences the learning experiences of students as they engage in inquiry PjBL, a case study design was appointed using both quantitative and qualitative data. Based on the research gap identified, an overarching research question was proposed: How does wiki technology influence students’ learning experience through inquiry PjBL? The following four sub-questions were devised to guide in data collection: (1) How well did wiki influence learning? (2) Did wiki promote motivation to learn? (3) How well did wiki promote group interactions? (4) How suitable is wiki as a form of technology to foster inquiry PjBL?

### *Participants and intervention program*

Inquiry PjBL were introduced to 420 Primary Five (P5) students from four local primary schools in Hong Kong (*FK*;  $n_1=65$ , *SP*;  $n_2=129$ , *HS*;  $n_3=87$ , *KSW*;  $n_4=139$ ). P5 students were chosen to ensure that the participants possess a certain level of literacy and IT skills for them to work independently on inquiry projects with Web 2.0 technology. The participating schools administered inquiry PjBL in a form of GS projects with the use of wiki as the collaborative platform. The students participated in an intervention programme for the entire academic year in which students were asked to work collaboratively on a General Studies group project on a wiki

platform. Each school decided on a different GS topic for their students to work on. Google Sites was selected for this study because it provides a multilingual interface which allows students to work in a more familiar environment using their mother tongue (Chinese) and hence be able to focus on their project content without being cognitively overloaded. The students were encouraged to do their works onto the wiki site which was only accessible to the corresponding school itself. Appropriate skills in information technology (IT), such as Chinese Input Methods, were taught at the beginning of the program to ensure that students were equipped with the necessary skills to carry out the GS project with wiki.

### *Data collection and analysis*

The outcomes of the project were assessed by a self-administered online survey which all participating P5 students (n=420) were invited to complete. The design of the survey, adapted from Hazari, North, and Moreland (2009), was anchored on a five point Likert-type scale (with 1 being “strongly disagree” and 5 being “strongly agree”), measuring the extent to which students agreed or disagreed with the 20 statements about wiki’s influence on the learning experience. This survey aimed to evaluate the wiki’s influence on students’ learning experience in four areas: (1) learning/pedagogy, (2) motivation, (3) group interaction, and (4) technology (See Table 1). Responses from all four schools were analyzed quantitatively as a whole. Focus group interviews were also conducted in all four schools to further document the findings. Students were asked to comment freely on their experience in completing their GS projects with wiki. Qualitative analysis was carried out on the students’ responses collected from the group interviews to uncover common themes which fit into the four areas assessed in the online survey.

TABLE 1: Online Survey

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Questions

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Factor 1: Learning/Pedagogy

- A1. Use of the Wiki enhanced my interest in the course (Google Sites 提高了我製作專題報告的興趣)
- A2. I would like to see Wikis used in other courses (我會嘗試繼續使用 Google sites 來學習和製作其他專題報告)
- A3. I will retain more material as a result of using the Wiki (使用 Google Sites 為我帶來更多知識)
- A4. I participated in the assignment more because of using the Wiki (Google Sites 令我更積極參與製作專題報告)
- A5. Use of the Wiki aided me in achieving course objectives (Google Sites 幫助我達成專題報告的目標)

Factor 2: Motivation

- B1. Benefit of using the Wiki is worth the extra effort and time required to learn it (我認為值得花精力和時間學習使用 Google Sites)
- B2. I would recommend classes that use Wikis to other students (我會推介其他同學使用 Google Sites 製作專題報告)
- B3. I would prefer projects that use Wikis over other projects that do not use Wikis (相比其他製作專題報告的方法, 我更喜歡使用 Google Sites 製作的專題報告)
- B4. I will continue to explore use of Wikis for project-works (我希望把 Google Sites 應用到其他專題報告)
- B5. I stayed on the task more because of using the Wiki (Google Sites 令我更集中完成專題報告的各項工作)

Factor 3: Group Interaction

- C1. I liked seeing other students' interaction with material I posted in the Wiki (我喜歡看同學在我的 Google Sites 上的留言)
- C2. Use of the Wiki for the assignment helped me interact more with students (利用 Google Sites 製作專題報告, 加強了我和組員之間的溝通)
- C3. Because of using the Wiki, my group was able to come to a consensus faster (Google Sites 令我的小組更快達成共識)
- C4. I learned more because of information posted by other students' in the Wiki (我從同學放在 Google Sites 的資訊中學會了更多)
- C5. Use of the Wiki promoted collaborative learning (Google Sites 促進協作學習)

Factor 4: Technology

- D1. The Wiki interface and features were overall easy to understand (Google Sites 的版面和功能清晰易用)
- D2. Benefits of using the Wiki outweighed any technical challenges of its use (使用 Google Sites 所帶來的好處多於操作時遇到的困難)
- D3. Browsing/editing information in the Wiki was easy (在 Google Sites 瀏覽及編輯資料是容易的)
- D4. Compared to other online discussion board, the Wiki was easier to use (Google Sites 比其他網上討論區更容易使用)
- D5. Technical features in the Wiki helped enhance my learning (在製作專題報告的時候, Google Sites 的功能促進我的知識增長)

## Findings and Discussion

All 420 participating P5 students were invited to fill in the self-administered online survey; however, the sample sizes for the different items vary because some students did not respond to some of the statements. The averages of the students' ratings on all of the 20 statements were above 3.0, the midpoint of the rating scale, indicating that students were positive about the influence of wiki on their experience with inquiry PjBL. Table 2 shows the quantitative analysis of the students' ratings.

Table 2. Students' responses to the influence of wiki in GS group project work.

Statements regarding wiki's influence on students' learning	Mean (SD)	Sample Size
<b>Factor 1: Learning/Pedagogy</b>		
A1. Use of the wiki enhanced my interest in the course	3.73 (±1.16)	385
A2. I would like to see wikis used in other courses	3.81 (±1.20)	384
A3. I will retain more material as a result of using the wiki	3.77 (±1.10)	384
A4. I participated in the assignment more because of using the wiki	3.65 (±1.10)	384
A5. Use of the wiki aided me in achieving course objectives	3.87 (±1.06)	385
<b>Factor 2: Motivation</b>		
B1. Benefit of using the wiki is worth the extra effort and time required to learn it	3.58 (±1.12)	383
B2. I would recommend classes that use wikis to other students	3.71 (±1.15)	380
B3. I would prefer projects that use wikis over other projects that do not use wikis	3.71 (±1.19)	384
B4. I will continue to explore use of wikis for project-works	3.75 (±1.15)	384
B5. I stayed on the task more because of using the wiki	3.73 (±1.09)	383
<b>Factor 3: Group Interaction</b>		
C1. I liked seeing other students' interaction with material I posted in the wiki	3.56 (±1.10)	385
C2. Use of the wiki for the assignment helped me interact more with students	3.64 (±1.11)	381
C3. Because of using the wiki, my group was able to come to a consensus faster	3.61 (±1.10)	385
C4. I learned more because of information posted by other students' in the wiki	3.63 (±1.11)	381
C5. Use of the wiki promoted collaborative learning	3.73 (±1.09)	383
<b>Factor 4: Technology</b>		
D1. The wiki interface and features were overall easy to understand	3.93 (±0.98)	386
D2. Benefits of using the wiki outweighed any technical challenges of its use	3.52 (±1.17)	384
D3. Browsing/editing information in the wiki was easy	3.84 (±1.09)	386
D4. Compared to other online discussion board, the wiki was easier to	3.59 (±1.21)	384
D5. Technical features in the wiki helped enhance my learning	3.76 (±1.07)	385

Notes:

1. The respondents answered according to a 5 point Likert-type scale, 1 (Strongly Disagree) and 5 (Strongly Agree). Items to which the respondents answered "don't know" and unanswered were not included in the analysis.
2. The mid-point of the rating scale is 3 (Moderate). Hence, any rating that is larger than 3.00 would be considered as edging towards positive perception and vice versa.

### *First factor: Learning/Pedagogy*

The first factor on learning/pedagogy assesses students' perceptions of wiki's influences on their learning experience. The influence is measured by the effectiveness of wiki in enhancing the students' interest in the course, retention of the material, active learning and the use of course materials in order to meet the course objectives. Among the five components contributing to the factor, the ratings were all on the positive side of the scale, indicating that students generally perceived wiki as an effective tool to foster learning. Students' learning interests were shown to be enhanced with the use of wiki. A student reported that he had "*little interest [in the*



*beginning] but after doing this project, [he] want[s] to learn more.*” The new learning approach also reinforced students’ knowledge acquisition by providing them opportunities to learn from experiences which are meaningful and significant to them (Dewey, 1916). Another student reported, “*After this project, I learnt that the harm of solar storm is closely related to us*”, suggesting that students became aware of the knowledge learnt through inquiry PjBL with wiki to be highly relevant to them.

### *Second Factor: Motivation*

One of the anticipated challenges towards implementing a wiki system to a cohort of 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 appeared to hold positive opinion on wiki as they generally agreed that the benefits associated with wiki outpaced the extra time and effort needed to learn about it. According to the students’ responses in group discussions, the user-friendly word editing function of the wiki, such as word-searching and spell check, had made “*working online more convenient*” when compared to the traditional pen-and-paper approach, and had given students “*the motivation to accomplish tasks*”. It appears that, despite the novelty of the technology, students were able to enjoy the convenience of its functions.

### *Third Factor: Group Interaction*

Students were positive about the wiki’s influence on group interaction. Communication among group members was enhanced and consensus was reached more efficiently owing to the use of wiki. Students generally showed enthusiasm in group collaboration on wiki. One of the students reported “*we love to exchange our data and ideas and give comments to each another*”. Another student commented that “*it is easier to communicate [via wiki] with each another*”, suggesting the wiki technology as an enabling tool for inquiry group projects. The students’ ratings and discussion responses demonstrated the generally positive attitude of students towards peers’ contribution to theirs project via wiki technology.

### *Fourth Factor: Technology*

Addressing the fact that wiki technology was relatively new to students, the fourth factor aimed to evaluate the wiki’s technological affordances. Notwithstanding the potential technical difficulties that might be encountered by the students, they perceived the impact of the technology on their learning to be positive. When compared to the more traditional way of completing a group project using a word processor, such as MS Word, students found that the online working platform allowed them to work on their projects “*anytime and anywhere*” in a simultaneous manner. In addition, being able to work online also facilitated the project completion as students “*can easily locate all the information [they] need online*”. The various

functions and features of the wiki technology were also perceived by students as user-friendly and helpful. A student evaluated the new mode of project completion and reported that “*Google Sites is better because we can quickly search all the information online, copy them and then save them into Google Sites, for the purpose of our project*”. The wiki appeared to be a desirable platform for the students to work collaboratively on their GS projects.

### **Limitations and Directions for Future Research**

As this study relied entirely on students’ self-reports on their learning experience with wiki and inquiry PjBL, future studies could incorporate more objective outcome measures to assess the effectiveness of wiki on the implementation of the new pedagogical approach. Such outcome could be the actual grades of the students’ final reports on wiki and the teachers’ comments and evaluation on students’ performance. Apart from this, teachers’ perceptions on the use of wiki in executing and monitoring inquiry PjBL could also be analyzed. To allow a clearer demonstration about the influences of wiki on students’ learning experience through inquiry PjBL, a control group could be introduced in which inquiry projects are administered without using wiki technology. Moreover, future research could utilize longitudinal designs with which students’ perceptions on wiki are documented and assessed at different points throughout the project completion period. Similar study could also be administered to students of different academic level for further comparison.

### **Conclusion**

The results of this study showed that wiki is an effective platform to deliver inquiry PjBL under Hong Kong primary education setting. The participating P5 students held high regard to the wiki platform and found the use of wiki in inquiry project facilitated their learning and group interaction. Despite the potential technical problems that might hinder students’ interest in exploring the new technology, it was perceived by the students that the technological constraints, if any, were worth extra time and effort to overcome. The user-friendly interface of wiki and the ease of accessing the online platform contributed to a higher motivation for learning amongst students.

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