
Grade 4 Students' Development of Research Skills Through Inquiry-Based Learning Projects

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Researchers like Harada, Yoshina, Donham, Bishop, Kuhlthau, and Oberg have pointed out the benefits for students to move from rote to inquiry learning. However, "the norm in many classrooms remains teaching practice that results in rote learning and regurgitated facts." In recent years, the Hong Kong government's Education Bureau has put inquiry-based learning as the first emphasis under the new General Studies curriculum for primary schools with the objective of "creating more learning space by removing obsolete content, allowing more time for inquiry-based learning." Many schools are now attempting to incorporate this mode of learning into their curriculum. This study reports on two phases of IBL projects undertaken by 141 grade 4 students, each phase lasting for two to three months. The projects were led by general studies teachers and heavily supported by Chinese-language teachers, the information technology teacher, and the school librarian. Through analyzing the lesson plans, in-class exercises, homework assignments, written reports, presentations by students, and data collected through surveys and interviews, this article focuses specifically on the role of the general studies teachers in guiding students through the inquiry process. It also analyzes the students' development of knowledge and research skills, as well as students' and parents' perceptions of the projects.

Introduction

Harada and Yoshina (2004a, 2004b), as well as Donham, Bishop, Kuhlthau, and Oberg (2001) have shown the benefits of inquiry-based learning (IBL) for students, as compared with rote learning. However, "the norm in many classrooms remains teaching practice that results in rote learning and regurgitated facts" (Harada & Yoshina, 2004b, p. 22). Harada and Yoshina might mainly be describing the situation in the United States, but this is in fact a worldwide problem. As in many other parts of the world, rote learning is still the dominant way of teaching and learning in Hong Kong primary schools (the equivalent of elementary schools in North America, grades 1-6). In attempting to change this situation, the Education Bureau (2002) of the Hong Kong Special Administrative Region introduced IBL into the general studies curriculum as a way to help students develop basic inquiry, investigative, and problem-solving skills.

This study reports two phases of IBL projects that were led by general studies teachers and heavily supported by the Chinese-language teachers, information tech-

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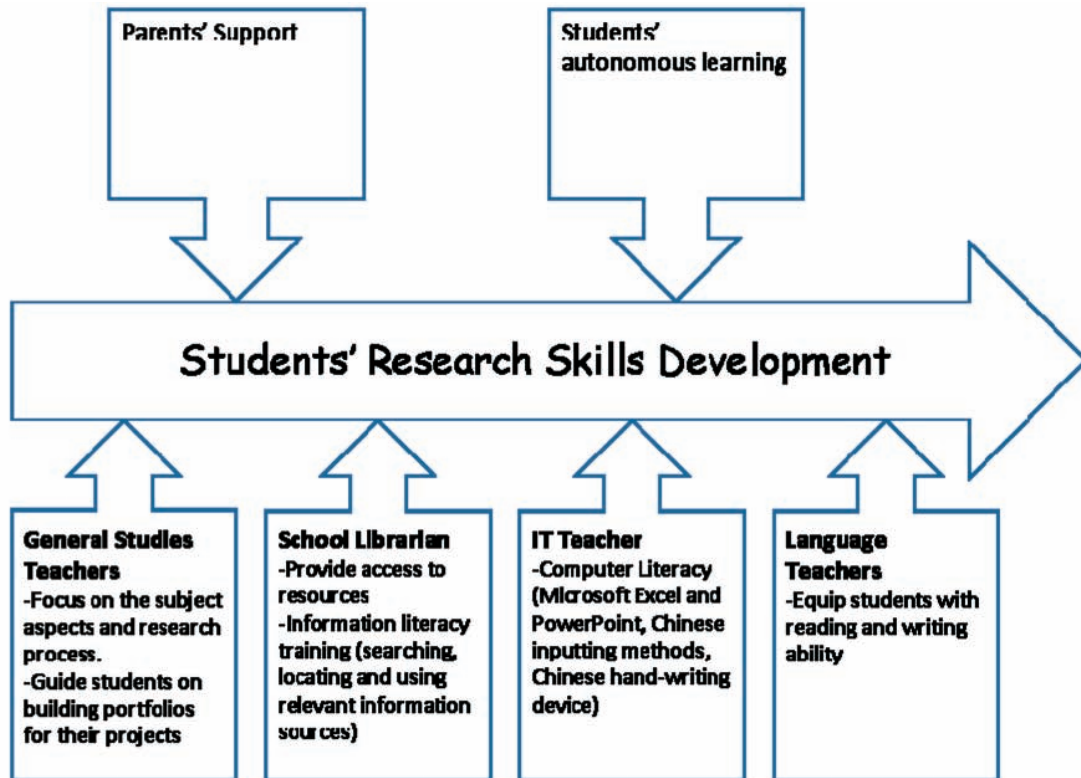


Figure 1. A model of the influences on students' research skills development through IBL.

nology (IT) teacher, and the school librarian. Each phase had 141 grade 4 students working on a research project lasting for two to three months. Through students' self-directed learning and support from the various teachers, school librarian, and parents (see Figure 1), students' research skills gradually developed.

Literature Review

What is IBL? The Education Bureau (2002) defines IBL as

a student-centered approach which helps students to integrate generic skills, knowledge and values in the learning of General Studies. In the inquiry process, students are active constructors of knowledge and the teacher is a facilitator of learning. Instead of the teacher giving the right answers, students have to raise questions, find their own answers and look for the necessary information. They are engaged in identifying problems, collecting information and solving the problems they encounter. (para. 1)

In the process of IBL, students are involved in cycles of questioning, investigation, verification, and generation of new questions (Harada & Yoshina, 2004a). It is also a kind of learning that "provokes deeper thinking and investigation and greater student motivation to learn" (Harada & Yoshina, 2004b, p. 22). Through this investigation, students are able to answer questions, develop solutions, or support certain viewpoints (Alberta Learning, 2004). In other words, interest and motivation are vital elements in inquiry learning (Kuhlthau, Maniotes, & Caspari, 2007).

Piaget's (1973) concept of autonomous learning requires children to discover relationships and ideas in the classroom through activities of interest to them. For this reason it has been noted that "the most successful curriculum inquiry projects emerge from topics that are of personal interest to the students" (Alberta Learning, 2004, p. 15). Kuhlthau, Maniotes, and Caspari (2007) reaffirm this by stating, "the curriculum and the student's world need to be closely aligned for deep personal learning to take place" (p. 8).

Vygotsky (1987) emphasized the importance of opportunities for active exploration. He claimed that children learn new cognitive skills under the guidance of an adult (or a more skilled person) through a process called scaffolding. In the classroom, teachers can assist children's discovery by providing scaffolding with questions, demonstrations, and explanations. In addition, the whole process has to be within the zone of proximal development of each child. In other words, the level of the assigned tasks must be too difficult for children to do alone, but they should be able to manage with guidance (Bee & Boyd, 2002).

A review of the literature suggests that the implementation of an IBL approach in schools includes the following seven key components.

1. Students are provided with rich information sources (Alloway et al., 1997; Jakes, Pennington, & Knodle, 2002);
2. Students are equipped with information literacy skills (Alloway et al.; Harada, 2002; Kuhlthau, 2003);
3. A climate of inquiry is created in the classroom (Alloway et al.; Hakkarainen, Lipponen, Jarvela, & Niemivirta, 1999);
4. Scaffolding support is provided to students in developing driving questions (Alloway et al.; Harada & Yoshina, 2004a; Jakes et al.; McKenzie, 1997);
5. Students go through an information-seeking process (Harada; Kuhlthau);
6. Students develop their own research process (Harada; Kuhlthau);
7. Students learn to present their findings (Alloway; Jakes et al.).

Owens, Hester, and Teale (2002) reported on the use of technology to support IBL programs for 7-15-year-old urban students. They suggested that technology enhances cognition, particularly in areas of reading and writing. Rather than as tutor and communicator of information, technology can serve as a ground for students' active construction of knowledge. Furthermore, access to technology makes schools seem more real-world, and students are able to push the boundaries of their traditional school curriculum. Wu and Hsieh (2006) investigated how grade 6 students develop inquiry skills of constructing explanations in an IBL environment. They designed a set of IBL activities that develop students' ability to construct explanation. The results showed that the students' inquiry skills were significantly improved after participating in the IBL activities. Bilal (2001) studied 17 grade 7 students (11-12-year-olds) who were required to use *Yahooligans!* to locate information for an assigned research task. She found that the students had difficulty in completing the task because they lacked adequate research skills.

Research has also indicated that effective school library programs, which are centers of IBL, can improve student achievement (Alberta Learning, 2004). Harada and Yoshina (2004a) and Kuhlthau (1994, 1997, 2003) studied how school librarians and teachers can work together in guiding students' inquiry learning. Literature is still

lacking, however, on how various subject teachers and the school librarian can work together in equipping students with inquiry learning and skills. This is especially true in the non-English-speaking world. Besides, little discussion exists on the specific role of general studies teachers in this collaborative teaching approach. Another gap in the literature relates to how students' research skills are developed through the process of IBL. This study, involving three subject teachers and the school librarian in supporting students' IBL activities, attempts to address these gaps.

Research Methods

This case study examined 141 grade 4 students from a local Hong Kong primary school. The design involved two phases, each having an IBL project assigned by general studies teachers, which the students were to complete with support from their Chinese-language teachers, IT teacher, and the school librarian.

Research Questions

The main research questions for this study are:

- What are the roles of a general studies teacher in an IBL project?
- How does the support from teaching staff and parents influence students' development of research skills through IBL projects?
- How do students develop their knowledge and skills in an IBL project?
- How well do students develop their research skills through IBL projects?

The Sample

This study comprised a sample of four classes of grade 4 students, all selected from one primary school, which was selected as a sample of convenience. Each class comprised approximately 30-40 students, and the average age of the students was 9. These students were all considered to be of average academic ability, from a school of average academic ranking.

A group of 11 teaching staff participated in the study, comprising the school librarian, five general studies teachers, four Chinese-language teachers, and the IT teacher. In addition, 27 parents agreed to be interviewed by telephone.

Instructional Design

Based on the models and guidelines created by Harada and Yoshina (2004a, 2004b) and Kuhlthau (1994, 1997, 2003), the first author and the school principal provided guidance and leadership in bringing together the teachers and school librarian to guide the grade 4 students over six months on projects that involved information research from printed and Internet sources.

During this period, students were asked to do two projects in two phases. The first phase was from November 27 to February 9, 2007 (10 weeks, excluding the holidays). In accordance with the school's planned curriculum, students were asked to choose a specific topic under the general theme "The Earth" for their group project. For the second phase, running from late March 2007 to May 30, 2007 (9 weeks), the general theme was "The History of Hong Kong and China." Under the guidance of their general studies teachers, students were given significant freedom in choosing their specific topics under the two general themes.

General studies teachers

All four general studies teachers spent two of their weekly classes (of which one was 50 minutes and one 30 minutes) to guide students through the inquiry learning projects. Students built their individual and group portfolios for the projects, which mainly contained relevant information sources. The general studies teachers focused on the subject aspect and research process of the projects. They judged whether students asked appropriate questions for the projects and whether they appropriately classified information and selected suitable materials to be included in their final written report and a project presentation at the end of each phase, which could be in the form of *PowerPoint*, drama, or cartoons.

The school librarian

The school librarian ensured that students were well equipped with the necessary information literacy skills to search, locate, and make use of relevant information sources for their projects. She provided students with a range of resources in a variety of formats including books, Web resources, and newspaper clippings to meet diverse needs and interests. She also arranged for a block loan of 200 books for the project from the Hong Kong Central Library. In both phases, a few library sessions (in collaboration with general studies teachers) were offered to students to enhance their information literacy skills. These served to familiarize them with the use of the library, searching WiseNews (a news database), the Web, the school library catalogue, and the public library catalogue. The sessions also included one homework assignment related to information literacy for each phase.

Language (Chinese) teachers

The language (Chinese) teachers focused on the development of the students' reading comprehension and writing abilities. They devoted a maximum of seven weekly classes in phase 1 and six in phase 2 (50 minutes each) in helping students to improve their reading and writing. In each class session, an article related to the project theme would be given to the students, who would then practice underlining the article's main points and writing some relevant remarks in both phases. To increase their interest in these tasks in phase 2, the students were also shown video clips related to the articles on which they were asked to work. Besides class work, students were asked to search and read three or more articles or books related to their research topics and write a weekly research journal (seven for phase 1 and six for phase 2) as homework.

The IT teacher

The IT teacher was responsible for equipping students with IT literacy skills and spent a number of classes (25-30 minutes each) in both phases to teach them the use of a Chinese handwriting device, Chinese input methods, Microsoft *PowerPoint*, Microsoft *Excel* for plotting graphs, and other relevant IT skills.

The first author and the school principal spent a year in discussion with the teachers and librarian about IBL to help them make the transition to this new teaching approach. He also worked with the teachers to reduce some of the existing assignments for students to make room for the new IBL-related assignments. This

arrangement was important in that both students and teachers would simply have a change in assignments rather than extra assignments to complete or mark. To avoid extra workload for the teachers, the first author worked closely with the teachers to produce lesson plans and exercises for the students.

The school principal and the first author conducted an introductory session for the students, explaining the essence of the inquiry-based approach of learning. A similar seminar was also held for parents. At this seminar, parents were asked not to offer help to their children unless absolutely necessary in order to ensure that students were able to conduct their self-directed learning. Parents who did not attend were informed about this in a circular letter.

Evaluation

The following areas were analyzed to answer our research questions.

Lesson plans, in-class exercises, and homework

The lesson plans provided a framework for the content of each lesson. Students were required to complete in-class assignments and homework in order to learn the various skills needed to complete their group work. The in-class tasks helped students practice the necessary skills for completing their research, whereas the homework helped them accumulate related information for their project.

Students' written reports and presentations

Students worked on their projects in groups of six. At the end of each group project, students were required to submit a written report and make a presentation. The general studies teachers evaluated students on these for each project. Students also did self- and peer evaluations for each project (Appendix C).

Surveys and interviews

The students were surveyed (Appendix A), and parents were interviewed by telephone. Teaching staff and the principal were also interviewed in person and/or by telephone. Both parents and teaching staff were interviewed using similar questions as asked of the students. Three general studies teachers were further interviewed with questions from Appendix B focusing on the extent of various research skills learned by the students from the IBL projects.

Findings and Analysis

In this section we briefly discuss the effectiveness of the IBL approach used in this study in helping students to improve various skills and abilities. We focus on an examination of the development of grade 4 students' research skills. General studies teachers' roles in guiding students through the inquiry process and the process of students' knowledge cultivation in IBL projects are investigated. Finally, we compare this year's general studies teachers' evaluations of students' IBL projects (and also students' self- and peer evaluations) with last year's.

Effectiveness of the Three Teachers' and Librarian's Collaborative Approach in Inquiry Learning

All students were surveyed on their thoughts about their IBL project shortly after phase 1. In addition, 27 parents (by telephone at about the same time as the students) and 10 teaching staff (4 general studies, 4 Chinese-language, 1 IT teacher, and 1 librarian) were interviewed using similar questions as asked of the students. A general studies teacher said, "This project has pulled different subjects teachers together. We saw this project as a joint effort between teachers in helping students become self-learners." One of the students commented, "The collaboration between the teachers and the librarian was very helpful, since they all worked together to help us learn how to look for relevant information, input Chinese, and use *PowerPoint*."

Table 1 shows how IBL projects were effective in offering students an enjoyable and challenging learning experience while enhancing their knowledge and skills through close collaboration of the teaching staff and parental support.

Table 1 indicates that students had a high degree of enjoyment (3.9 out of 5, with 5 as *very much so* for teaching staff; 4.0 out of 5 for parents; and 3.8 out of 5 for students) in accomplishing the inquiry-based project. It also indicates that the difficulty level of the students' projects was appropriate: not too easy and not too difficult (3.0 out of 5, with 5 as *very easy* for teaching staff; 3.5 out of 5 for parents; 3.3 out of 5 for students). The italicized portion of Table 1 shows the level of perceived improvement in eight

Table 1
Perceptions of Teaching Staff, Parents, and Students on the Inquiry-Based Project

<i>Interview/Survey Questions</i>	<i>Teaching staff</i>	<i>Parents</i>	<i>Students</i>
1. Enjoyment of doing the project ^a	3.9	4.0	3.8
2. Level of difficulty of the project ^b	3.0	3.5	3.3
3. Parental support ^c	n/a*	2.4	2.7
4. <i>Information literacy</i> ^c	4.0	3.7	3.6
5. <i>Reading interest</i> ^c	3.7	3.1	3.5
6. <i>Reading ability</i> ^c	3.9	3.3	3.5
7. <i>Writing ability</i> ^c	3.7	3.2	3.5
8. <i>Computer literacy</i> ^c	3.8	3.4	3.3
9. <i>Knowledge of the research topic</i> ^c	4.2	3.6	3.9
10. <i>Communication skills</i> ^c	3.8	3.4	3.7
11. <i>Research skills</i> ^c	3.6	n/a**	3.5
12. Overall support from school ^c	3.9	3.7	3.7

Notes

^a The respondents answered according to a scale of 1-5, with 1 as not enjoying and 5 as enjoying very much;

^b The respondents answered according to a scale of 1-5, with 1 as very difficult and 5 as very easy;

^c The respondents answered according to a scale of 1-5, with 1 as the lowest and 5 as the highest.

* Teaching staff's views were not sought because parental support was not observable by the teaching staff.

** Parents' views were not sought because they were asked to take a rather passive role in this project so they might not know their children's development in this area.

areas of student abilities. All scores were over 3, which indicates a reasonably high level of improvement achieved in all eight areas according to the parents, students, and teaching staff (see Chu, Tang, Chow, & Tse, 2007, for a detailed discussion of how this IBL approach led to an improvement in students' various skills and abilities).

One general studies teacher commented, "It was expected that students would use *PowerPoint* for their presentation, but the use of drama, videos, or other means to do their presentation were beyond our expectations. They have learned to use drama or videos to convey their message showing their improvement in creativity and cooperation."

Students' Improvement in Research Skills

Improvement in students' research skills is closely related to their knowledge of the research topic, which is the area of greatest improvement (Table 1) perceived by students, parents, and teaching staff (3.6 out of 5 for parents; 3.9 out of 5 for students; and 4.2 out of 5 for teachers). Parent 18 said her child now, "knows how to ask questions precisely, and to critique his own opinion."

In this section we first compare students' and teaching staff's perceptions of students' improvement in research skills and then discuss two factors influencing this improvement: parental and teaching staff support.

Students' and Teaching Staff's Perceptions of Students' Improvement in Research Skills

As shown in Table 1, both students and teaching staff felt that the students' research skills were greatly improved (3.5 out of 5 for students and 3.6 out of 5 for teaching staff), although they exhibited a degree of difference. Of 141 students, 78% responded with a 3 or above—implying that they had improved in their research skills through the IBL project—whereas 91% of the teaching staff chose 3 or above. In other words, nearly all teaching staff felt that students had achieved great improvement in their research skills. It is also interesting to note that about a quarter (24%) of the students selected 5 to show that they had learned a great deal in research skills, whereas none of the teachers was so exuberant.

Influence of Parental and Teaching Staff Support on Students' Development of Research Skills

Figure 1 shows how the collaboration of the teaching staff with appropriate support from parents can help students develop their research skills. The following section provides more details on support from the teaching staff and parents in facilitating students' learning in the IBL projects.

Parental Support

Like problem-based learning, IBL calls for self-directed learning (Blumberg, 2000) where students take control of their own learning. This includes choosing their topics with guidance from the teacher and finding relevant sources for their project. For genuine success in these aspects, it is important to keep parental support at a minimum. In other words, parents should step in only when their children are having serious difficulties. This was an important point to address as parents in Hong Kong tend to

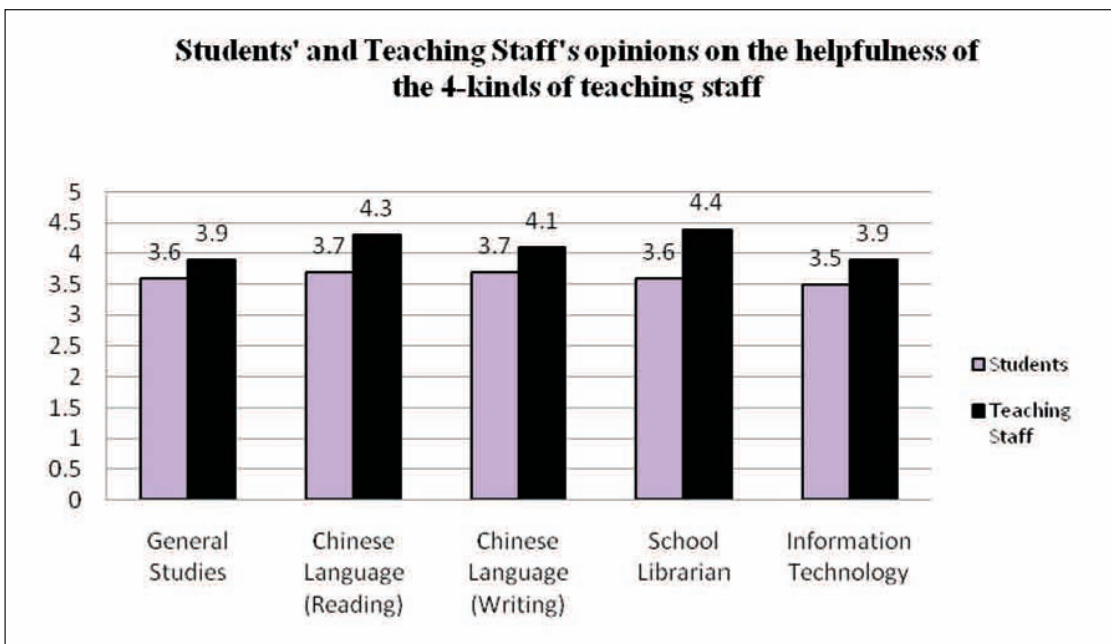
provide a great deal of help to their children in their homework in the hope that they will “do it right.” So parents were notified about this through a workshop and distribution of a circular letter. It was emphasized that the focus of this project was on learning rather than having students find the “right answer” to their problems.

Both parents and students indicated that minimal parental support was offered during the inquiry-based projects (2.7 out of 5 for students; and 2.41 out of 5 for parents). For example, parent 1 revealed that he or she would “only offer help upon request made by their children, and (for example) when the child could not find certain kind of information, the parent will teach the child to search online, e.g., on Yahoo, or on Web sites recommended by the teachers.” One difference between students’ and parents’ responses was that the students perceived themselves as receiving more support from their parents than the parents believed they were giving.

Overall, the results show that the project was successful in bringing the self-directed mode of learning to students. Moreover, several parents commented on their children’s newfound independence during the IBL projects and that they had needed to offer hardly any support.

Teaching Staff Support

This study examines a collaborative approach of three kinds of subject teachers (general studies, Chinese-language, and IT) and the school librarian in supporting students in their inquiry-based group projects. Table 1 shows that the overall support from the school (mainly provided through the collaborative effort of the teachers and the librarian) was perceived as high by students, parents, and teaching staff with scores of 3.7, 3.7, and 3.9 respectively.



Note. Scales from 1 to 5: 1 is *not at all*; 5 is *very much so*.

Figure 2. Students’ and teaching staff’s perception on the helpfulness of various teaching staff in supporting the students’ projects.

Figure 2 provides details of the help students received from various teachers and the librarian for their projects. Both students and teaching staff felt that the support from all four teaching staff was helpful in equipping students with the knowledge and skills needed to complete their group projects. Small differences are shown, however, between the perceptions of students and those of teaching staff. The students valued the help received from their Chinese teachers (in terms of the effectiveness of the in-class assignments and weekly research journals in improving their reading and writing abilities) slightly more than that received from others. The teaching staff, though, believed that the help students obtained from the school librarian was the most valuable (in terms of equipping them with information literacy skills needed for the project) compared with help received in other areas.

Role of the General Studies Teachers

The general studies teachers' primary role is to support students in the inquiry learning projects. In the words of the school principal, "The role of general studies teachers in implementing the inquiry learning project is to serve as a guide to the students." This view is also reflected by the general studies teachers, one of whom stated that they "were the facilitators in the lessons," and another said, "the students play a leading role while the teacher assists them."

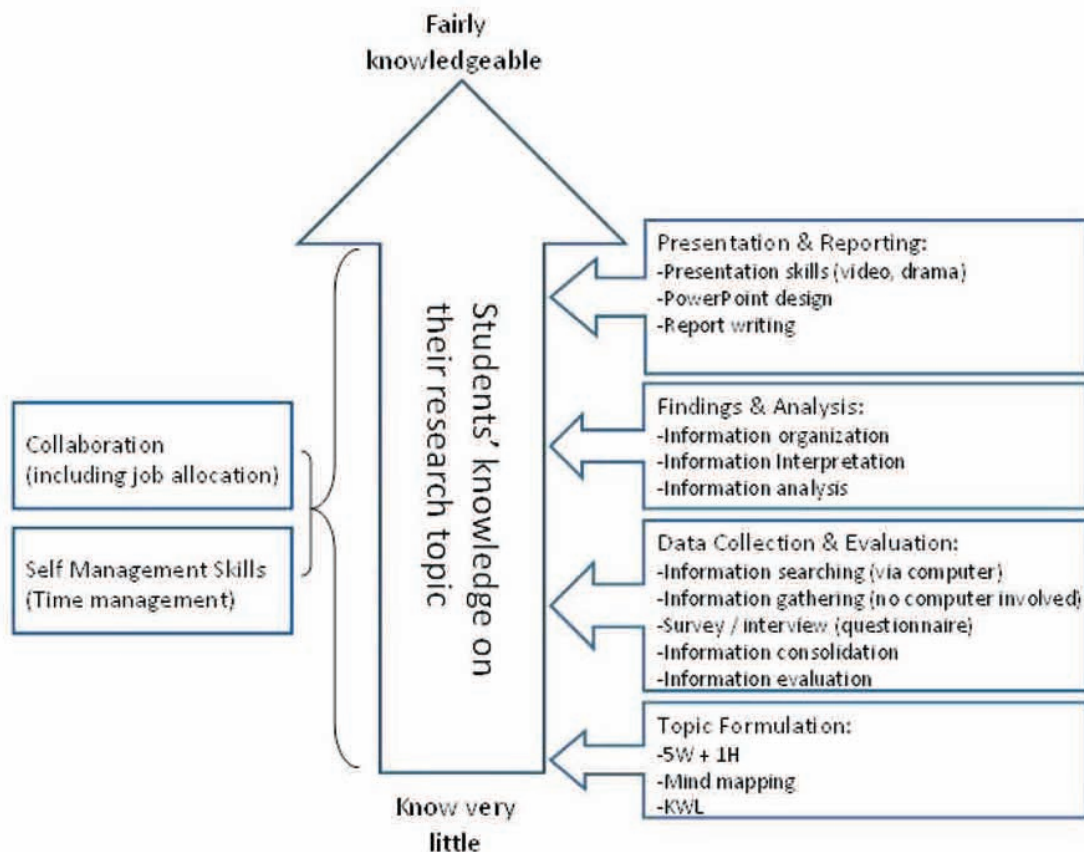


Figure 3. The process of knowledge cultivation through the IBL project.

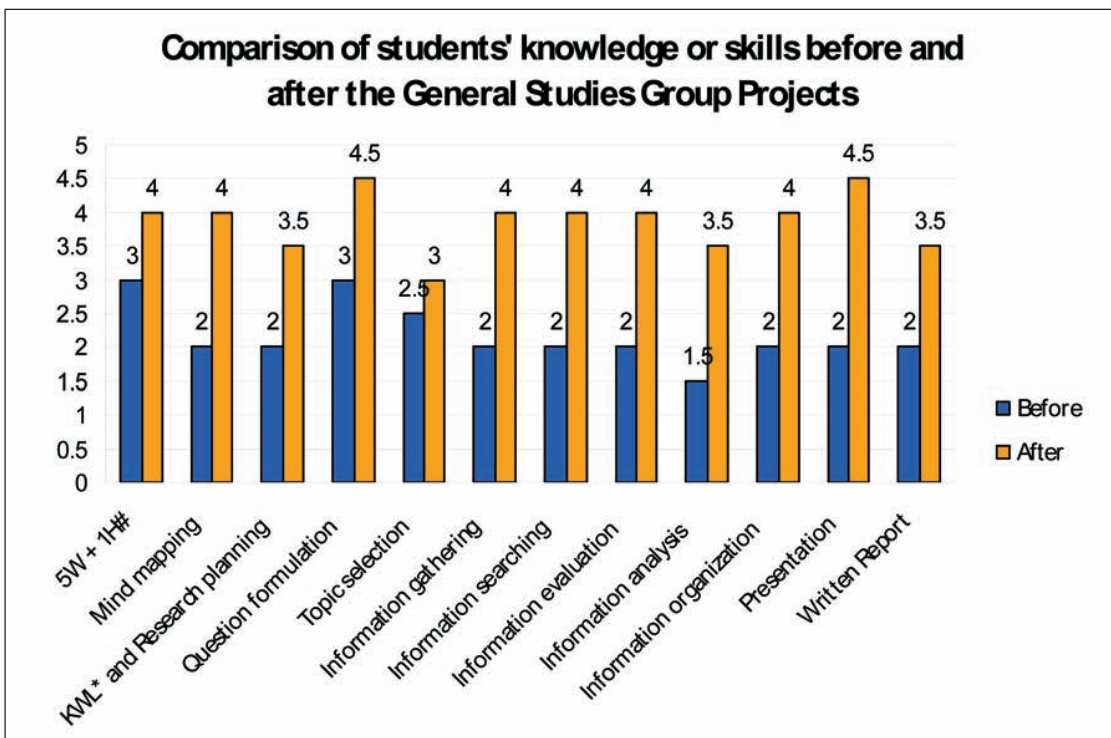
As guides, the general studies teachers led the students through the inquiry-based projects each week in two lessons totaling 1.5 hours. One class was for teaching students research skills (e.g., brainstorming, formulating questions, and organizing data); another was for group discussion about the group portfolio and presentation design (*PowerPoint*, video, skit, or other means in their presentations). They also assigned in-class exercises and homework to students to consolidate their research skills and knowledge. When necessary, the general studies teachers sought help from other teaching staff, from the Chinese-language teachers, for example, when students needed to write introductions and summaries for their projects. Finally, they regularly checked on students' progress and provided advice and direction when students encountered problems that they could not solve on their own.

Students' Knowledge Cultivation in the IBL Projects

At the end of each inquiry-based project, general studies teachers found that students' knowledge on their research topic was greatly enhanced. The process the students followed to increase their knowledge is illustrated in Figure 3.

A model of students' knowledge cultivation process

Figure 3 shows that the skills and knowledge involved in IBL can be grouped into four stages: topic formation, data collection and evaluation, findings and analysis, and presentation and reporting. It has been noted that collaboration is an important



Note. Scale from 1 to 5: 1 is *very little*; 5 is *very much*.

Figure 4. General studies teachers' evaluation of students' research skills before and after the IBL projects.

activity for students to work through in their research work (Kuhlthau, 2004). This study found that it is essential for students to work collaboratively in all phases of their knowledge cultivation process.

General studies teachers were asked to rate students' research-related knowledge or skills before and after the general studies group projects (Appendix B). Figure 4 shows the general studies teachers' ratings in the questionnaire. It indicates that in the view of these teachers, students gained significant improvement in their knowledge and skills after the group projects.

The presentation skills were rated the highest and were also the most improved (2 out of 5 before the project; 4.5 out of 5 after the project). General studies teachers expressed that students' had improved in all the aspects, but they showed great interest in the presentation. These teachers were also impressed by the students' creative presentations such as staging a drama.

In addition, general studies teachers believed that students had greatly improved in their skills in collecting and analyzing information. On average, students improved by 2 points for each skill of information-gathering, searching, evaluation, analysis, and organization. These teachers commented that students tried various techniques for finding information, for example, designing questionnaires, searching for relevant sources from the Internet and WiseNews (Chow et al., 2007), and also looking at newspapers and books. They also used various methods to process the information after the in-class exercises.

A Four-Step Process of Students' Knowledge Cultivation

Wu and Hsieh (2006) pointed out that "Formulating, evaluating and communicating explanations have been identified as essential features of classroom inquiry" (p. 1289). General studies teachers equipped students with various basic skills and guided them to complete their research work for the projects. These teachers commented that students apparently improved in their research skills and in their knowledge of the selected topic after the group projects. Figure 5 shows how students' knowledge was built through learning in the various stages of the projects. The process of students' knowledge cultivation involves four major steps.

Step 1: Topic formulation

During the topic exploration and formulation stage in the first three lessons, general studies teachers guided the students' thinking mainly by three methods: 5W+1H (Who? Why? What? Where? When? How?), mind map, and KWL (What I *know*; What I *want* to know; What I *learned*). Students went through the process of brainstorming, discussions, and finally decided on a feasible topic. Compared with students the previous year, general studies teachers awarded 18.79-40.00% higher average points to *question formation* for students (Appendix D). This shows that students had learned to formulate their research topics systematically.

Step 2: Data collection and evaluation

After formulating the project topic, students started to collect related information. To facilitate them in doing this, the school librarian helped the students by providing them access to relevant resources and by equipping them with skills in searching,

locating, and using various information sources. Students also completed two substantial information literacy assignments at their information literacy sessions to reinforce learning (Chu, Chow, Luk, Cheung, & Sit, 2007).

In general studies teachers' evaluation, students this year gained a 21.38-44.52% increase in their average points in related evaluation criteria (including information-gathering and searching and information evaluation) compared with students the previous year (Appendix D).

General studies teachers indicated that students learned to use more data collection methods. For example, they were able to search the Internet and WiseNews, conduct a survey, and obtain information from museums and libraries. They also acquired more advanced information search skills such as using Boolean operators in their search. The school librarian commented that students were able to use several keywords for searching, and although they sometimes encountered problems, they were at least willing to try.

Step 3: Findings and analysis

Collected data must be organized and analyzed to make them meaningful. Chinese-language teachers taught students some reading techniques to help them understand and evaluate the information collected. General studies teachers awarded 60.00% and 28.00% higher average points in arithmetic ability and data analysis respectively to students this year compared with last year (Appendix D). This suggests that students' knowledge of organizing information and analyses improved through the IBL project.

Step 4: Presentation and reporting

The final step was to write a report and make a presentation on the findings of the project. The IT teacher taught students computer literacy skills for presentation, and Chinese-language teachers guided them in writing reports (Chu et al., 2007). Compared with students the previous year, average points of students this year were increased by 34.62% and 26.06% in communication skills and IT literacy respectively (Appendix D).

General studies teachers said that students were enthusiastic about the presentation. Many groups designed their presentations in a nontraditional way and showed creativity. In addition to *PowerPoint* slides, some students presented using video clips or even singing. General studies teachers were impressed that students were able to present their knowledge of the topic and related information. For example, general studies teacher H said, "There was a student who could tell his group mates the whole story regarding certain history events."

Most students were not able to use Chinese typing in their written reports because they had lacked time to learn the correct input method, as reported by the IT teacher. However, the quality of written reports was not affected by this low level of skill. Students managed to present their ideas and enhanced them by using varied colors and attractive drawings.

General Studies Teachers' Evaluation of Students' Performance in IBL Projects

General studies teachers evaluated students' performance in IBL projects using the criteria listed in Appendix D. The scores of the grade 4 students this year (2007) were

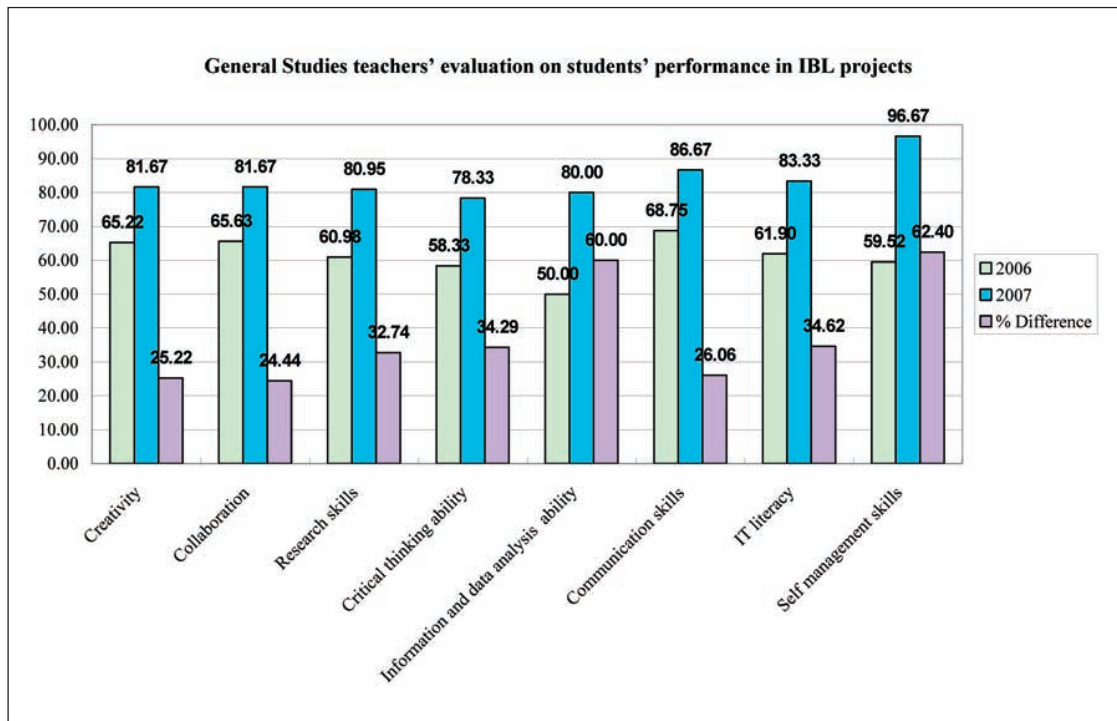


Figure 5. General studies teachers' evaluation of students' performance in IBL projects.

compared with those of grade 4 students in 2006. The evaluation criteria used can be consolidated into eight areas as compared in the histogram shown in Figure 5.

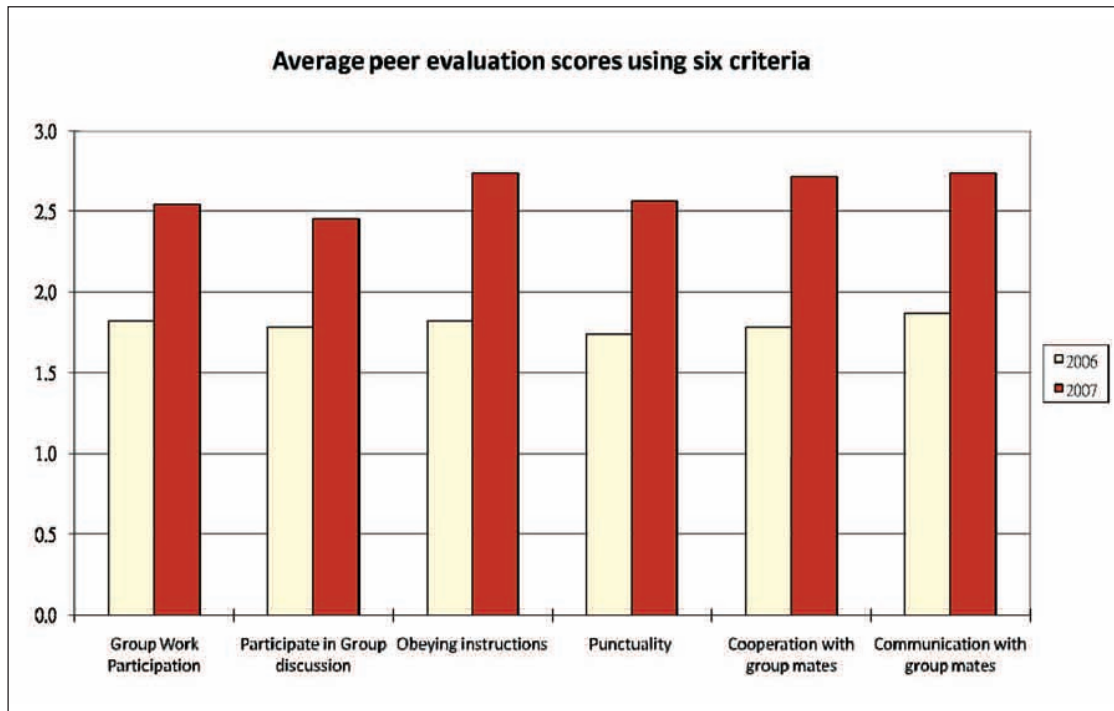
Figure 5 shows that students this year (2007) performed better than students last year for similar general studies projects. All figures for both years were derived from the best project(s) in each of the four primary 4 classes. For 2006 the sample size was four, whereas for 2007 it is five because one class had two best projects with the same grade. Students this year on average scored higher in all evaluation criteria than students last year. On average, students this year scored 37.47% higher average points across all criteria. Students' greatest improvement was in self-management skills followed by arithmetic ability.

Students also improved 32.72% in research skills (Figure 5). This shows that the collaborative approach of three kinds of teachers and the librarian in providing students support in inquiry learning projects is highly effective in advancing students in all learning pointers commonly set for group project-based learning.

Besides the support from the three teachers and the librarian, it is also important for parents not to intervene too early into their students' autonomous learning. If they did, the projects would be the parents' and not the students'. It is reasonable to assume that parents did not offer significantly more help this year than last year because parents in general behave similarly from year to year. And parents this year were asked to help their children as little as possible.

Students' Self-Evaluation and Peer Evaluation on the IBL Projects

Students evaluated their own performance and also that of their most admired group mate with six criteria. Figures 6 and 7 compare the average self- and peer evaluation



Note. Scale is from 1-3 points.

Figure 6. Students' peer evaluation on the IBL projects.

scores of students in 2006 (N1=24) and 2007 (N2=23).

According to Figure 6, the evaluation scores of the most admired students in 2007 increased by an average of 1.2 (45.59%) across the six criteria compared with students in 2006. This aligns with the earlier findings that students overall improved a great deal in various skills related to doing a group project. The two most improved areas of the most admired students were cooperation with group mates and obeying instructions.

Figure 7 shows that the students in 2006 ranked themselves higher than did the students in 2007. The general studies panel teacher said that this might be due to an increased level of difficulty in the projects and a higher demand for the use of computers in 2007. However, the sample size is not large enough to make a conclusive explanation.

Table 2 shows students' major suggestions for areas for improvement for their most admired group members. Compared with 2006, it is worth noting that more students tried to write their opinions on areas where other members could improve (75% in 2007 and 67% in 2006) and that students gave more similar comments. For example, in 2007 punctuality (25%) and cooperation with group mates (17%) were mentioned, whereas information collection (17%) was the only more common comment in 2006. These are also the aspects mentioned most frequently (more than 50% of the students). The increase in the number of students giving written comments may be related to students' improvement in writing abilities following the IBL project. Also, it is interesting to note that when students were asked to suggest additional reasons why they most admired a given student, they elected personality traits such as conscientious and more active.

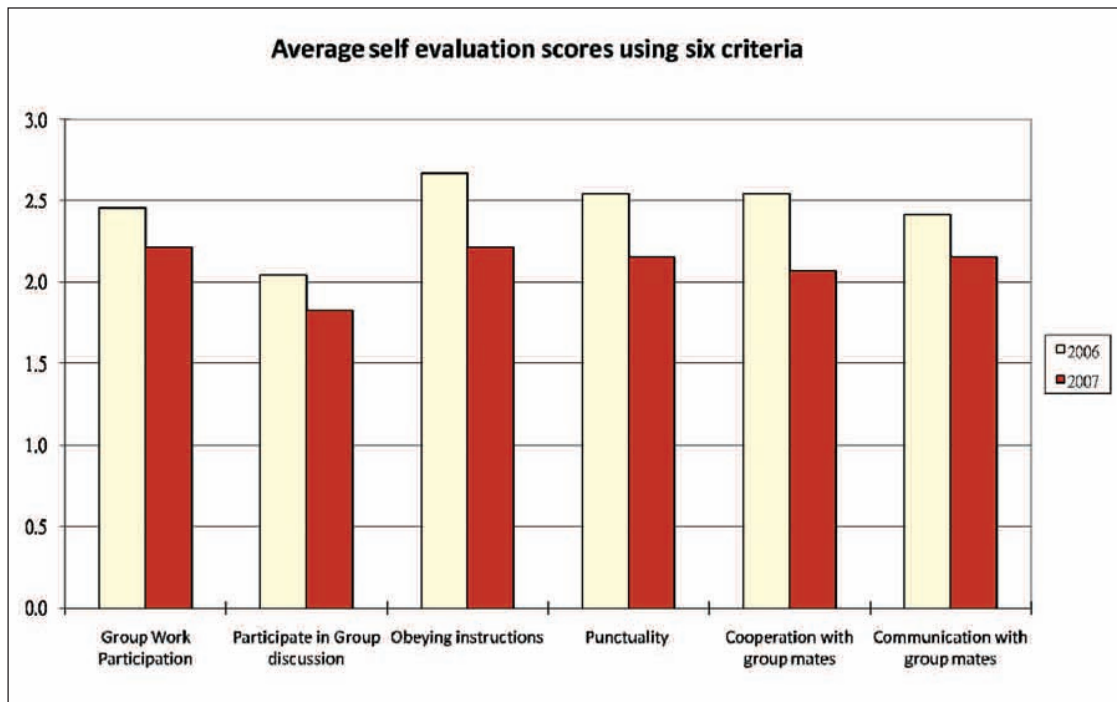


Figure 7. Students' self-evaluation on the IBL projects.

Table 3 lists students' main comments on areas on which they themselves could improve. Compared with 2006 results, it is worth noting that more students tried to write down their opinions on areas in which they could improve (85% in 2007 and 58% in 2006), which could be because of their improved writing abilities.

Among the opinions listed in Table 3, active participation in group discussion (21%), cooperation with group mates (15%), and communication with group members (13%) were more commonly mentioned. This suggests that more group-based activities should be arranged to familiarize students with group work so as to increase their confidence and efficiency. Also, students in 2007 elaborated more on

Table 2
Students' Major Opinions on Areas on Which
Their Most Admired Group Member Can Improve

Aspects	No. of students' comments in 2006	No. of students' comments in 2007	Total no. of students' comments
Punctuality	1	6	7
Information collection	4	1	5
Cooperation with group mates	1	4	5
Active involvement in group work	1	2	3
Active participation in group discussion	2	1	3
Communication with group mates	1	1	2

Table 3
Students' Major Opinions on Areas on Which They Themselves Can Improve

<i>Aspects</i>	<i>No. of students' comments in 2006</i>	<i>No. of students' comments in 2007</i>	<i>Total no. of students' comments</i>
Active participation in group discussion	4	3	7
Cooperation with group mates	1	4	5
Communication with group mates	1	3	4
Punctuality	1	2	3
Work harder	1	1	2
Presentation (of report)	1	1	2
Information collection	1	1	2

self-evaluation and reflection on completion of the research study. This includes how hard-working they were, how they could use a better approach in the research study (e.g., delegate tasks more effectively), and what they had learned from it (e.g., improved communication and interpersonal skills).

Conclusion

This study showed that a collaborative approach involving three kinds of teachers and the school librarian in equipping students with the knowledge and skills they needed to conduct IBL projects works effectively. Moreover, students' various skills and abilities were greatly enhanced in the process. To foster students' development in research skills, our findings suggest that general studies teachers should take a supporting role as facilitator, advisor, and guide in the students' inquiry learning process. To promote students' autonomous learning through the projects, parents should help their children as little as possible.

In this study we also created a model of students' knowledge-cultivation process in which their knowledge of their research topics was built up gradually through learning and practice in four steps: topic formulation, data collection, findings and analysis, and presentation and reporting. It is important for students to work collaboratively throughout the process.

The most striking finding in this study is that grade 4 students this year achieved a much higher quality in their general studies projects than students in the previous year: about 40% more points were given by the general studies teachers this year. Students' peer evaluations suggested the same, with an increase of 46% more points awarded for their most admired students this year than last year. This again reflects that the four-teaching-staff approach in guiding students through IBL projects is an excellent way of supporting students with what they need for the projects.

Limitations and Further Studies

A major limitation of this study is the small sample size of parents; although the principal investigator wrote to all parents inviting them to participate in a telephone interview, only 27 agreed to participate. Those who agreed to be interviewed might

have been those who noticed their children's progress, and they might thus favor the inquiry-based-learning approach promoted by the researcher. Similarly, the project sample size was also small, as was the students' self-evaluation. Further studies might use larger samples, which would be more representative.

Also, further research could be undertaken on the use of IBL with students of differing academic abilities. All students in this study were of average academic ability, and they were seen to improve their knowledge and skills significantly through working on IBL projects.

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References

- Alberta Learning. (2004). *Focus on inquiry: A teacher's guide to implementing inquiry-based learning*. Edmonton, AB: Author, Learning and Teaching Resources Branch.
- Alloway, G., Bos, N., Hamel, K., Tracy, H., Klann, J., Lyons, D., Madden, T., Margerum-Leys, J., Reed, J., Scala, N., Soloway, E., Vekiri, I., & Wallace, R. (1997). Creating an inquiry-learning environment using the World Wide Web. *Journal of Network and Computer Applications*, 20, 75-85.
- Bee, H., & Boyd, D. (2002). *Lifespan development* (3rd ed.). Boston, MA: Allyn and Bacon.
- Beishuizen, J., Wilhelm, P., & Schimmel, M. (2004). Computer-supported inquiry learning: Effects of training and practice. *Computers and Education*, 42(4), 389-402.
- Bilal, D. (2001). Children's use of the Yahoo!igans! Web search engine II: Cognitive and physical behaviors on research tasks. *Journal of the American Society for Information Science and Technology*, 52(2), 118-36.
- Blumberg, P. (2000). Evaluating the evidence that problem-based learners are self-directed learners: A review of the literature. In D.H. Evensen & C.E. Hmelo (Eds.), *Problem-based learning: A research perspective on learning interactions* (pp. 199-226). Mahwah, NJ: Erlbaum.
- Chow, C.K.K., Chu, S.K.W., Ng, S.H., Fong, C.S.J., Kwan, W.Y., & Leung, A.A.T. (2007, December 14-15). *WiseNews database for primary four inquiry-based learning projects*. Paper presented at the conference on integrated learning, Hong Kong Institute of Education, Hong Kong.
- Chu, S., Chow, K., Yim, Y., Chow, J., Ha, N. & Fung, H.F. (2007, December 14-15). *Primary four students' development of writing ability through inquiry-based learning projects*. Paper presented at the conference on integrated learning, Hong Kong Institute of Education, Hong Kong.
- Chu, S., Chow, K., Luk, Cheung, K. & Sit, D. (2007, December 14-15). *The development of primary four students' information literacy and information technology skills*. Paper presented at the conference on integrated learning, Hong Kong Institute of Education, Hong Kong.
- Chu, S., Tang, Q, Chow, K. & Tse, S.K. (2007, July 16-20). *A study on inquiry-based learning in a primary school through librarian-teacher partnerships*. Paper presented at the IASL conference, National Taiwan Normal University, Taipei, Taiwan.
- Donham, J., Bishop, K., Kuhlthau, C.C., & Oberg, D. (2001). *Inquiry-based learning: Lessons from Library Power*. Worthington, OH: Linworth.
- Education Bureau, the Government of the Hong Kong Special Administrative Region. (2002). *General studies for primary schools curriculum guide*. Retrieved September 5, 2007, from: http://cd.edb.gov.hk/kla_guide/GS_HTML/english/ch4/ch42
- Hakkarainen, K., Lipponen, L., Jarvela, S., & Niemivirta, M. (1999). The interaction of motivational orientation and knowledge-seeking inquiry in computer-supported collaborative learning. *Journal of Educational Computing Research*, 21(3), 263-281.
- Harada, V.H. (2002). Personalizing the information search process: A case study of journal writing with elementary-age students. *School Library Media Research*, 5. Retrieved October 10, 2006, from: <http://www.ala.org/ala/aasl/aaslpubsandjournals/slmrb/slmrcontents/volume52002/harada.htm>

- Harada, V.H., & Yoshina, J.M. (2004a). *Inquiry learning through librarian-teacher partnerships*. Worthington, OH: Linworth.
- Harada, V.H., & Yoshina, J. M. (2004b). Moving from rote to inquiry: Creating learning that counts. *Library Media Connection*, October. pp. 22-24.
- Jakes, D.S., Pennington, M.E., Knodle, H.A. (2002). *Using the Internet to promote inquiry-based learning*. Retrieved October 8, 2006, from: <http://www.biopoint.com/inquiry/ibr.html>
- Kuhlthau, C.C. (1994). Students and the information search process: Zones of intervention for librarians. In I. Godden (Ed.), *Advances in librarianship* (pp. 57-72). Academic Press.
- Kuhlthau, C.C. (1997). Learning in digital libraries: An information search process approach. In F. Jacobson (Ed.), *Children in digital libraries*. *Library Trends*, 45(4), 708-724.
- Kuhlthau, C.C. (2003). Rethinking libraries for the information age school: Vital roles in inquiry learning. *School Libraries in Canada*, 22(4), 2-5.
- Kuhlthau, C.C. (2004). *Seeking meaning: A process approach to library and information services* (2nd ed.). Westport, CT: Libraries Unlimited.
- Kuhlthau, C.C., Maniotes, L.K., Caspari, A. K. (2007). *Guided inquiry: Learning in the 21st century*. Portsmouth, NH: Libraries Limited.
- McKenzie, J. (1997). The question is the answer. Creating research programs for an age of information. *FNO.ORG*, 7(2). Retrieved October 8, 2006, from: <http://www.fno.org/oct97/question.html>
- Owens, R.F., Hester, J.L., & Teale, W.H. (2002). Where do you want to go today? Inquiry-based learning and technology integration. *Reading Teacher*, 55(7), 616-625.
- Piaget, J. (1973). *To understand is to invent*. New York: Grossman.
- Wu, H.K., & Hsieh, C.E. (2006). Developing sixth graders' inquiry skills to construct explanations in inquiry-based learning environments. *International Journal of Science Education*, 28(11), 1289-1313.
- Vygotsky, L.S. (1987). Development of higher mental functions during the transitional age. In R.W. Rieber (Ed.), *The collected works of L.S. Vygotsky* (pp. 83-150). New York: Plenum Press.

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Appendix A

Inquiry-Based Learning at Canossa: Questionnaire for All P4 Students

(Some parts of the questionnaire not related to this article are omitted.)

Class: _____

Name: _____

Please answer the following questions based on your experiences from Phase I of the project.

1. What topic is your group working on for the inquiry learning project?

2. Do you enjoy working on the inquiry learning project?

<i>Not at all</i>				<i>Very much so</i>
1	2	3	4	5

3. How difficult did you find the inquiry learning project?

<i>Very difficult</i>				<i>Very easy</i>
1	2	3	4	5

4. How helpful do you find the assignments from General Studies in equipping you to do the inquiry based learning project?

<i>Not at all</i>				<i>Very much so</i>
1	2	3	4	5

5. Do you find the in-class assignments from Chinese Studies helpful in improving your ability in reading comprehension?

<i>Not at all</i>				<i>Very much so</i>
1	2	3	4	5

6. Do you find the in-class assignments and the weekly research journals from Chinese Studies helpful in improving your writing skills?

<i>Not at all</i>			<i>Very much so</i>	
1	2	3	4	5

7. How helpful do you find the teaching/guidance from the school librarian in equipping you with the information literacy skills needed to find and evaluate relevant sources for your project?

<i>Not at all</i>			<i>Very much so</i>	
1	2	3	4	5

8. How helpful do you find the teaching/guidance from the IT teacher in equipping you with IT skills (keyboarding, the use of *PowerPoint*, etc.) you need for your project?

<i>Not at all</i>			<i>Very much so</i>	
1	2	3	4	5

9. Do you find the overall support from school sufficient in equipping you with the knowledge and skills to tackle the project? (e.g., broad loan from public library and the joint class activities regarding this project)

<i>Not at all</i>			<i>Very much so</i>	
1	2	3	4	5

10. How much help did your parents offer when you were working on your project?

<i>None</i>			<i>A lot</i>	
1	2	3	4	5

11. Does the project help you improve in the following aspects?

<i>Aspect</i>	<i>None</i> 1	2	3	4	<i>A lot</i> 5
Ability in finding information (e.g., can find relevant articles/books more easily)					
Interest in reading (e.g., read more books/articles)					
Reading ability (e.g., read faster, can identify the main points in articles more quickly)					
Writing ability (e.g., can write with a wider base of vocabulary)					
Computer related skills (e.g., <i>PowerPoint</i> , Chinese word processing)					
Knowledge about the research topic					
Communication skills with other students					
Presentation skills (Verbal)					
Research skills (e.g., ability to ask questions)					

Appendix B
Inquiry-Based Learning at Canossa:
Questionnaire for Teachers (General Studies)

Class: _____

Name: _____

Please answer the following questions based on your experiences from both Phase I and II of the inquiry based learning project.

1. When compared to the way you teach General Studies before the inquiry based learning project, do you see any change in your role as the General Studies teacher in guiding your students through the projects?

Yes / No

If yes, how has your role been changed?

2. If "yes" for question 1, how essential do you see this change in your role on students' learning in the projects?

<i>Not essential at all</i>					<i>Very essential</i>	
1	2	3	4	5		

Please explain? _____

3. Compared to the P4 students last year, did your students this year perform better in the General Studies group projects?

<i>Not at all</i>					<i>Very much so</i>	
1	2	3	4	5		

Why? _____

4. Compared to the P4 students last year, did you assign higher grades for the General Studies group projects?

<i>Not at all</i>					<i>Very much so</i>	
1	2	3	4	5		

Why? _____

The following questions are related to the *in-class exercises* that you assigned for your students to prepare them for the General Studies group projects.

5. What did the students do in the in-class exercises that were related to the General Studies group projects?

6. How well did your students perform in the in-class exercises for the group projects?

<i>Very poorly</i>			<i>Very well</i>	
1	2	3	4	5

7. How helpful do you find the in-class exercises in equipping your students for the General Studies group projects?

<i>Not helpful at all</i>			<i>Very helpful</i>	
1	2	3	4	5

The following questions are related to the *homework* that you assigned for your students to prepare them for the General Studies group projects.

8. What did the students do in the homework that was related to the General Studies group projects?

9. How well did your students perform in the homework for the group projects?

<i>Very poorly</i>			<i>Very well</i>	
1	2	3	4	5

10. How helpful do you find the homework in equipping your students for the General Studies group projects?

<i>Not helpful at all</i>			<i>Very helpful</i>		
1	2	3	4	5	

The following questions are related to the *research skills development* through the General Studies group projects.

11. Did the General Studies group projects help your students improve their research skill development?

<i>Not at all</i>			<i>Very much so</i>		
1	2	3	4	5	

12. Please rate the students' research related knowledge/skill in the following aspects before and after the General Studies group projects.

<i>Aspect</i>	<i>BEFORE the projects</i>					<i>AFTER the projects</i>					
	<i>Very Little</i>					<i>Very Much</i>	<i>Very Little</i>				<i>Very Much</i>
	1	2	3	4	5	1	2	3	4	5	

5W + 1H#

Mind mapping

KWL* and Research planning

Question formulation (asking)

Topic selection

Info gathering (no computer is involved)

Info searching (via computer)

Information evaluation

Information analysis

Info organization

Presentation

Written Report

5W + 1H: *Who? Why? What? Where? When? How?*

* KWL: *What I KNOW; What I WANT to Know; What I LEARNED*

Appendix C

Students' Self- and Peer Evaluation on the Inquiry Learning Group Project

(A) Students' self evaluation

Topic: _____ Name: _____

Class: _____ Date: _____

Through the group project, I can:

- | | | | |
|---|---|---|---|
| 1. Actively participate in the group work | ☺ | ☺ | ☺ |
| 2. Actively participate in group discussion | ☺ | ☺ | ☺ |
| 3. Obeying instructions to do the project | ☺ | ☺ | ☺ |
| 4. Complete the project on time | ☺ | ☺ | ☺ |
| 5. Cooperate with my group mates | ☺ | ☺ | ☺ |
| 6. Communicate well with my group mates | ☺ | ☺ | ☺ |

7. Others: _____

8. Areas could be improved: _____

(B) Students' peer evaluation

Topic: _____ Name: _____

Class: _____ Group: _____ Date: _____

In Group _____, I most admire _____, because in this group project, s/he can:

- | | | | |
|---|---|---|---|
| 1. Actively participate in the group work | ☺ | ☺ | ☺ |
| 2. Actively participate in group discussion | ☺ | ☺ | ☺ |
| 3. Obeying instructions to do the project | ☺ | ☺ | ☺ |
| 4. Complete the project on time | ☺ | ☺ | ☺ |
| 5. Cooperate with my group mates | ☺ | ☺ | ☺ |
| 6. Communicate well with my group mates | ☺ | ☺ | ☺ |

7. Others: _____

8. Areas could be improved: _____

☺ Average ☺ ☺ Satisfactory ☺ ☺ ☺ Very satisfactory

Appendix D General Studies Teachers' Evaluation of Students' Performance in IBL Projects

<i>Teachers' evaluation criteria</i>		<i>Average Points* in year 2007</i>	<i>Average Percentage in year 2007</i>	<i>Average Points in year 2006</i>	<i>Average Percentage in year 2006</i>	<i>Average Points Difference between 2007 and 2006</i>	<i>Percentage difference</i>
<i>Creativity</i>	Question formulation	2.45	81.67%	2.06	68.67%	0.39	18.79%
	Research value	2.50	83.33%	2.06	68.67%	0.44	21.21%
	Feasibility	2.40	80.00%	1.71	57.00%	0.69	40.00%
<i>Collaborative Skills</i>	Research planning	2.30	76.67%	1.88	62.67%	0.43	22.67%
	Information gathering and searching	2.60	86.67%	2.00	66.67%	0.60	30.00%
<i>Research Skills</i>	Information quality	2.20	73.33%	1.81	60.33%	0.39	21.38%
	Questionnaire design	2.25	75.00%	1.83	61.00%	0.42	22.73%
	Sampling (Target)	2.13	71.00%	1.58	52.67%	0.54	34.21%
<i>Collaboration, Communication, and Problem solving Ability</i>	Collaboration	2.60	86.6%	2.06	68.67%	0.54	26.06%
	(Cooperation)						
<i>Research Skills</i>	Information organization	2.80	93.33%	1.94	64.67%	0.86	44.52%
	Information consolidation	2.50	83.33%	1.75	58.33%	0.75	42.86%
	Information interpretation	2.40	80.00%	1.88	62.67%	0.53	28.00%
<i>Critical Thinking Skills</i>	Information analysis						
	Information evaluation	2.30	76.67%	1.63	54.33%	0.68	41.54%
<i>Information and Data Analysis</i>	Data analysis	2.40	80.00%	1.50	50.00%	0.90	60.00%
	Expression						
<i>Communication Skills</i>	IT Literacy	2.60	86.7%	2.06	68.67%	0.54	26.06%
	IT Literacy	2.50	83.33%	1.86	62.00%	0.64	34.62%
<i>Self Management Skills</i>	Time Management	2.90	96.67%	1.79	59.67%	1.11	62.40%
	Adheres to Assignment Timeline						

* Based on a scale of 1-3, with 1 as the lowest and 3 as the highest. General Studies teachers assigned a grade for each of the elements in the table above in regards of students' written reports for their group projects. The figures for both years were derived from the best project(s) in each of the four Primary 4 classes. For the year 2006, sample size is 4; whereas the sample size is five for the year 2007 because one class has two projects with the highest and an identical grade