Inquiry project-based learning and web 2.0 technologies: 21st century skills education

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Abstract: The 21st century world shaped by rapid technological advancement has resulted in shifting needs and demands for societies. As a result, a new set of skills, such as critical thinking skills, information literacy and collaboration skills, is expected to be developed by students in the 21st century. This paper presents findings suggesting that new pedagogical approaches combining inquiry learning, collaborative teaching and use of social media are effective in facilitating the development of students’ 21st century skills. The teachers’ and students’ perceptions also give insights on how the pedagogies could be best implemented to maximize its positive influence on students’ learning experience.

Keywords: inquiry learning, 21st century skills, collaborative teaching, social media

Introduction

The rapidly changing structure of the world has resulted in a subsequent shift of skills demanded on people. In the 21st century, three sets of skills have been identified to be among the most in demand: (1) learning and innovation skills, (2) information, media, and technology skills (collectively referred to as ‘digital literacies’), and (3) life and career skills [36]. New pedagogical approaches have come to the fore to facilitate students’ development of these skills and literacy [25; 39], with a global trend of learning in schools moving from the traditional didactic approach towards inquiry learning, which requires students to be “active constructors of knowledge” [9, p. 133]. One of the most discussed teaching approaches is inquiry project-based learning (inquiry PjBL). Although a great deal of research has shown positive teaching and learning efficacy of inquiry-based learning [12; 18; 21], the actual implementation of the strategy has not been explicitly discussed. When this approach is implemented in an inappropriate manner, it is possible that this would significantly hinder students’ learning [10]. Although inquiry PjBL has been promoted by educators around the world, students and teachers have encountered challenges in adopting this new teaching and learning approach [3]. Acknowledging these challenges, this paper presents findings from two studies that examined the potential of supporting inquiry PjBL with two new pedagogical approaches: collaborative teaching and the use of social media.

1. Literature Review

1.1 21st century skills

The 21st century is an information age where the acceleration of digital technology
development has required people to be equipped with related digital skills and literacy [1]. Further, globalization has shaped business across the world to become more knowledge-based, mobile, and collaborative in nature [13]. Meanwhile, machines have been replacing human workforce in tasks consisting of routine cognitive and manual work, such that people are now appointed to jobs that emphasize expert thinking and complex communications [24]. The term ‘21st century skills’, referring to the skills that are “not new, just newly important” [40], are the skills required of the human workforce of the 21st century which have been heavily influenced by technological advancement. Amongst others (e.g., [33] and [35]), the framework proposed by Partnership for 21st Century Skills [36] has been most widely adopted by schools. See Table 1 for detailed components of 21st century skills proposed by P21.

Table 1. P21 21st century skills framework

<table>
<thead>
<tr>
<th>3 skill sets:</th>
<th>Learning and Innovation</th>
<th>Digital Literacies</th>
<th>Life and Career Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>12 components:</strong></td>
<td>Critical thinking and problem solving</td>
<td>Information literacy</td>
<td>Flexibility and adaptability</td>
</tr>
<tr>
<td></td>
<td>Communication</td>
<td>Media literacy</td>
<td>Imitative and self-direction</td>
</tr>
<tr>
<td></td>
<td>Collaboration</td>
<td>Technology</td>
<td>Social and cross-cultural interaction</td>
</tr>
<tr>
<td></td>
<td>Creativity and innovation</td>
<td>literacy</td>
<td>Productivity and accountability</td>
</tr>
</tbody>
</table>

1.2 Inquiry Project-based learning (Inquiry PjBL)

The Education Bureau of Hong Kong describes inquiry-based learning (IBL) as a student-centered approach that promotes the integration of skills, knowledge, and values in learning [14]. The combination of IBL and project-based learning (PjBL), which involves the carrying out of an investigative project [2; 30; 42], results in an innovative pedagogical approach called inquiry PjBL. Inquiry PjBL differs from the more traditional didactic teaching approach where knowledge is transmitted in a unidirectional way from teachers to students [24]. It is reported that such approach is effective and promising in development students’ abilities such as research skills, subject knowledge, and writing abilities [6; 8; 16].

1.3 Collaborative teaching approach

Collaborative teaching, which emphasizes teachers’ joint efforts in co-planning and implementing teaching strategies [15], has been found to be beneficial in enhancing student learning [22; 34; 43]. In terms of project monitoring, it enables teachers to better monitor and scaffold their students as coordination of teaching staff is reinforced [43]. The involvement of librarians in the collaborative teaching team has been advocated by information literacy (IL) researchers and practitioners [12; 19]. The growing involvement of librarians in collaborative teaching, characterized by partnerships between librarians and subject teachers [12] has been explored in a number of recent studies [7; 23; 32; 33; 44]. In such collaborative teaching team, subject teachers contribute their domain knowledge while librarians are responsible for developing students’ IL skills, enabling them to evaluate and use relevant information [18]. Figure 1 illustrates the collaborative teaching model that has been used in the studies discussed in the paper.
1.4 Use of social media (wiki) in teaching and learning

The integration of social media (e.g., blogs, wikis) into teaching and learning has been seen as beneficial [10; 4; 38]. A wiki is often described as “a collaborative web space where anyone can add content and anyone can edit content that has already been published” [38]. Studies on the application of wiki in education – from primary to tertiary level, across different subject areas including Chinese, English, General Studies, Geography, Science, Knowledge Management and Information Management – have shown its positive influence to students’ learning experience (e.g. [7; 17; 26; 28; 29; 37; 41; 45; 46; 47]). Pifarre and Starrman (2011) pointed out that wiki provides a platform for students to exchange ideas and accomplish tasks together, through which process their critical thinking and problem-solving skills [46] and social skills [17] are sharpened. Chu (2008) found that wiki has promoted collaboration among students, which lead to an enhancement of work quality. Specifically, wikis have been perceived to be enabling in equipping students with 21st century skills, such as communication and collaboration skills [48].

2. Research Objectives

The paper presents findings on two studies that examined the effectiveness of inquiry learning, collaborative teaching and use of wiki in facilitating the development of students’ 21st century skills.

**Study 1: Inquiry project-based learning (inquiry PjBL) with collaborative teaching**

1. To measure the improvement on students’ eight learning dimensions.
2. To explore perceptions of difficulty and support of the inquiry PBL model as perceived by the participants.

**Study 2: Use of social media (wiki) to support inquiry learning**

1. To explore students’ perceptions on the influence of the use of social media (wiki) in inquiry learning on their learning experiences.
3. Methodology

3.1 Inquiry project-based learning (inquiry PjBL) with collaborative teaching

This study involved three groups of participants: (1) students; (2) their parents; and (3) the teaching staff. Over a period of six months, 142 primary level 4 (P4) students in a local primary school were asked to do two General Studies (GS) projects in two phases (Phase 1 covered 10 weeks; Phase 2 covered 9 weeks). The teachers and the school librarian were instructed to work together to guide their students on the projects. Teachers were mainly responsible for subject knowledge teaching while school librarian focused on equipping students with information literacy. Questionnaires were administered to teachers, students and parents upon project completion. In the questionnaires, the perceived improvements of students in eight learning dimensions were measured. All three participant groups answered the questions for dimensions 1 to 6, but only the students and teachers were asked for responses for dimensions 7 and 8. Parents were not asked about their children’s presentation and research skills as they might not have adequate knowledge or observations of these aspects. Perception of difficulty of the project and perception of support provided were also measured. Degree of project difficulty, helpfulness of project components, school support, and parental participation was measured using a close ended question, with a 5-point scale for answer options. SPSS 16.0 was used for statistical analyses.

3.2 Use of social media (wiki) to support inquiry learning

Google Sites was used in four primary schools in Hong Kong in which students (n=420) did inquiry group projects for the GS subject, implemented over a period of 2 to 3 months. To evaluate the use of wiki, an online survey was administered to all P5 students who participated in the GS group project upon project completion. The online survey consisted of 20 questions that examined four factors: learning/pedagogy, motivation, group interaction and technology [20]. The questionnaire was anchored on a 5-point Likert-type scale which measured the extent to which students agreed or disagreed with the 20 statements that described wiki’s influence on their learning (with 1 being “strongly disagree”, 5 being “strongly agree”). Statistical significance was set at p<0.05. SPSS 16.0 was used for statistical analyses.

4. Findings and Discussion

4.1 Inquiry project-based learning (inquiry PjBL) with collaborative teaching

Both the parents and the students rated the tasks as easy, while the teacher’ ratings were in the middle of the scale (see Table 2), signifying a neutral perception. The overall support provided by the school was also perceived as sufficient by all the participants. However, while the teaching staff considered that students had been given a high level of support, the parents gave relatively lower ratings, and offered suggestions on how the school could further facilitate student learning, such as providing a venue for the students’ meetings and improving the IT skills support. In terms of the influence on students’ learning dimensions, all three parties were found to hold positive perceptions, with all ratings higher than 3.0, i.e. the mid-point of the scale (see Table 3). All these dimensions are examples of 21st century
skills which are expected to be acquired by students. The teachers generally held more positive perception on students’ improvement on the eight learning dimensions than the students and the parents. The teachers and the students rated improvement of subject knowledge the highest, whereas the parents gave the highest rating for information literacy improvement.

Table 2. Mean of the participant groups’ rating responses for their perception of tasks and support from the collaborative components.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Teaching staff Mean / SD</th>
<th>Parents Mean / SD</th>
<th>Students Mean / SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N_teaching = 11)</td>
<td>(N_parents = 27)</td>
<td>(N_students = 141)</td>
</tr>
<tr>
<td>1. Perceived difficulty/ease of project*</td>
<td>3 ± .82</td>
<td>3.5 ± .93</td>
<td>3.31 ± .99</td>
</tr>
<tr>
<td>2. Overall school support‡, i, ii, iii</td>
<td>3.9 ± .57</td>
<td>3.26 ± .99</td>
<td>3.71 ± .69</td>
</tr>
<tr>
<td>3. Helpfulness of GS assignments‡</td>
<td>3.86 ± .38</td>
<td>NA</td>
<td>3.63 ± 1.17</td>
</tr>
<tr>
<td>4. Helpfulness of Chinese assignments‡</td>
<td>4.43 ± .53</td>
<td>NA</td>
<td>3.67 ± 1.09</td>
</tr>
<tr>
<td>5. Helpfulness of research journals‡</td>
<td>4.14 ± .69</td>
<td>NA</td>
<td>3.65 ± 1.01</td>
</tr>
<tr>
<td>6. Helpfulness of librarian‡</td>
<td>4.29 ± .75</td>
<td>NA</td>
<td>3.58 ± 1.04</td>
</tr>
<tr>
<td>7. Helpfulness of IT teacher‡</td>
<td>3.86 ± .69</td>
<td>NA</td>
<td>3.47 ± 1.27</td>
</tr>
</tbody>
</table>

Notes:
* The respondents were answering according to a scale of 1-5, where 1 was ‘very difficult’ and 5 was ‘very easy’.
‡ The respondents were answering according to a scale of 1-5, with 1 as ‘not at all’ and 5 as ‘very much so’.
i Sample size of students = 140; ii Sample size of parents = 24; iii Sample size of teaching staff = 10. (Source: Chu, 2009).

Table 3. Participants’ perceptions on the dimensions of learning benefits from inquiry PjBL and collaborative teaching.

<table>
<thead>
<tr>
<th>Dimension of learning</th>
<th>Teaching staff Mean / SD</th>
<th>Parents Mean / SD</th>
<th>Students Mean / SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 11)</td>
<td>(n = 27)</td>
<td>(n = 141)</td>
</tr>
<tr>
<td>1. Information literacy</td>
<td>4.00 (.63)</td>
<td>3.74 (.68)</td>
<td>3.60 (1.12)</td>
</tr>
<tr>
<td>2. Reading ability</td>
<td>3.91 (.30)</td>
<td>3.26 (.99)</td>
<td>3.48 (1.07)</td>
</tr>
<tr>
<td>3. Writing ability</td>
<td>3.73 (.65)</td>
<td>3.18 (1.07)</td>
<td>3.48 (1.11)</td>
</tr>
<tr>
<td>4. IT skills</td>
<td>3.82 (.60)</td>
<td>3.37 (1.02)</td>
<td>3.28 (1.21)</td>
</tr>
<tr>
<td>5. Subject knowledge</td>
<td>4.18 (.75)</td>
<td>3.60 (.96)</td>
<td>3.88 (1.05)</td>
</tr>
<tr>
<td>6. Social and communication skills</td>
<td>3.82 (.75)</td>
<td>3.40 (.83)</td>
<td>3.72 (1.1)</td>
</tr>
<tr>
<td>7. Presentation skills</td>
<td>4.00 (.82)</td>
<td>n/a</td>
<td>3.40 (1.13)</td>
</tr>
<tr>
<td>8. Research skills</td>
<td>3.50 (1.14)</td>
<td>n/a</td>
<td>3.60 (.52)</td>
</tr>
</tbody>
</table>

Note: The respondents rated the influence of inquiry PjBL on different dimensions of learning according to a scale of 1–5, where 1 refers to (none) and 5 refers to (a lot) (Source: Chu, 2009).

4.2 Use of social media in inquiry learning

Table 4 shows that the average of the students’ responses on the rating scales indicates positive perceptions on the effects of wiki on the four aspects of learning (all above the mid-point 3.0) which entail 21st century skills such as collaboration and IT skills.
Students’ ratings on ‘Learning/Pedagogy’ were all in the positive side of the scale, indicating that they perceived wiki as an enabling tool for learning. While students tended to perceive wiki as helpful in achieving course objectives, they also supported the use of wiki even in other school subjects. Students also reported that the use of wiki enhanced their motivation for the group projects. Students appeared to believe that the benefits associated with using wiki are worth their time and energy resources devoted to learning it. Enhanced communication within groups was also perceived as one of the major benefits associated with the use of wiki. Further, students perceived wiki to have facilitated collaboration, and thus shared learning during their group project implementation. Despite wiki being a relatively new learning platform for students, the impact of technology was perceived to be positive. Specifically, the interface and technological features of wiki were deemed generally easy to understand. Students also found that managing information materials on the wiki was efficient.

5. Conclusion

In this information-explosion era, 21st century skills are deemed essential for students to overcome challenges in future workplace. As educators continue to search for teaching approaches that could effectively develop students’ 21st century skills, inquiry PjBL appears to be effective in fostering such development. To ensure that students benefit from inquiry PjBL, carefully planned teaching strategies are needed. Implementing inquiry PjBL through a collaborative teaching approach, which mainly involves subject teachers, school librarians and school administrators, has been shown to have a positive impact on both students and teachers. Evidence of students’ improved performance suggests that inquiry PjBL supported with collaborative teaching strategies is a promising pedagogical approach in facilitating the development of students’ 21st century skills. Apart from collaborative teaching, the use of social media tools, such as wiki, in facilitating the implementation of
inquiry PjBL has also shown to have positive effects on students’ learning experiences by enhancing their learning interests, motivating them to achieve a higher level of performance and encouraging peer learning and interactions. The findings of these studies have provide empirical evidence for educators and researchers to formulate a proper way of implementing inquiry learning with a major aim to facilitate students’ 21st century skills development.

References


