Using Classified Social Bookmarking of Network Knowledge to Improve Elementary Students’ Science Problem-Solving Ability

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Abstract—This study explored students’ information sorting ability and problem-solving ability on the effect of using classified Social Bookmarking of network knowledge. A quasi-experimental research design was conducted in a medium elementary school in northern Taiwan. The results showed there was a positive effect on information sorting ability and problem-solving ability. It also implies that students built an information organizing model by using classified Social Bookmarking of network knowledge to assist project-based inquiry learning. The internalized model starts from information needs, clarifying main topic, searching keywords, browsing, selecting, reading, searching for solutions, tags recording as bookmarks, classifying, and uploading to share.

Keywords—social bookmarks; information sorting ability; problem-solving ability

I. INTRODUCTION

Although the highly developed internet provides a sustained environment for Project-based inquiry learning, Lawrence and Giles [1] argued that users might suffer some difficulties, especially the elementary students, to find out proper and correct information while immersing in the abundant, fast growing but not stable digital network. However, the search engines offer a shortcut for information searching, which is also the most common way to look for information as typing the keywords and clicking into the hyperlinks it shows [2]. Despite the convenience nowadays the search engines supply, problems of ineffective exploring were still reported [3-4] such as receiving different results when using different search engines sponsored by different companies, invalid hyperlink provided, improper contents embedded in the web sites and so on. There are only few websites specially designed for elementary students. Therefore, information searching on internet becomes so challenging and skills demanded for young users that they need more experiences and continued practice to filter out the core of the matter from messy internet information. It imposes heavy burden and makes frustration when young users are browsing back and forth the web pages, digging in and singling out the points under immature cognitive development.

Around 2003, the revolution happened to change the methods and the behavior of information retrieving. Internet users not only obtain messages from centralized entry websites, but also deliver their messages through interactive web pages. As long as some people submit their personal bookmarks on internet, the others can share and re-edit the bookmarks as their own, e.g. the earliest Social Bookmark service “del.icio.us”, and “Blinklist”, “Furl”, “HEMiDEMi” “MyShare”[5-6].

Social Bookmarks have been recursively edited, reviewed and shared by a great deal of users all over the world, which means the filtered information has been chosen and is more valuable for learners to select the messages and pick up as their network knowledge [6]. For the sake of this, this study adopted the method of using classified Social Bookmarking of network knowledge to improve elementary students’ science problem-solving ability. The research purposes are drawn as below:

1. To explore the difference of students “information sorting ability” applying the methods using “classified Social Bookmarking of network knowledge” and “traditional teaching” on science course.

2. To explore the difference of “problem-solving ability” applying the methods using “classified Social Bookmarking of network knowledge” and “traditional teaching” on science course.

II. THEORETICAL FOUNDATIONS

Internet information searching usually provides users with far heterogeneous data from different searching systems [2]. Other problems like the highly frequent change of data, the database growing too fast and so on often make students fall in information searching if they are not capable of making plans and using appropriate
internet search strategies [7]. One of the common mistakes students would make, for example, is that they use a whole sentence as a keyword to search. They don’t know how to select proper keywords to fit the database. They do not fully understand about the topic which they are searching. Not being able to make accurate assessment to the searching results, the students are easy to distract the focus of the problem and not familiar with the function of search engine, e.g. Boolean Expression. Besides the basic skills of searching, the ability of synthesis and summarizing are the core to problem-solving [8-9]. Therefore, teachers have to guide their students to solve the problems with useful strategies.

A. Classified Social Bookmarking of Network Knowledge

Web2.0 is a new era in networking which has powerful functions and good prospects. The integration of Web2.0 and collaborative learning building will bring Collaborative Knowledge Building (CKB) into a new stage. Web2.0 concept is an idea fitting with CKB since Web2.0 is characterized by being user-centered, the two-ways communication, and creating knowledge together in social network formation, while CKB is a process which involved the participants in collecting knowledge, communicating knowledge, sharing knowledge, and creating knowledge together [10-11]. However, how to integrate the undoubted significant factors into the CKB process is a question in Web2.0 era. Based on Web2.0 technologies and social software, learners can gain plenty of open resources, convenient learning environment, and timely communication with partners and teachers [12]. Web 2.0 applications innovate traditional informative services, providing web users with a set of tools for publishing and sharing information [13]. Unfortunately, the growing amount of available resources makes it tough to get access to relevant information in these environments [14].

Web bookmarking, also called Social Bookmarking or Collaborative tagging, is one of the Web 2.0 applications which offers URL hyperlinks collections and sharing service [5]. Collaborative tagging has emerged as a useful mean to organize and share resources on the web [15]. Recommender systems have been utilizing tags for identifying similar resources and generate personalized recommendation [16]. By using the service, users can collect, classify, gather and share internet information such as internet news, pictures, or media data. Moreover, users are able to organize and modify internet information with personalized tagging function. The continuum of recursive process has been a new model of information organizing, which emphasizes that people would not only receive the information passively but cast to interact initiatively instead [17-23].

B. The Ability to Solve the Problems

The ability of problem-solving demands a complex and high-structuralized mental activity [24]. Based on Dignath’s research [25], a meta-analysis of 48 treatment comparisons from 30 articles on enhancing self-regulated learning amongst primary school students, problem-based learning (PBL) relates to self-regulated learning which considers motivational, cognitive, and meta-cognitive aspects.

1) The Definition of Problem-Solving

The cognitive activities of human are always purpose-oriented, and we overcome the barriers because we expect to reach what we want. From this perspective, most of the cognitive activities, such as forming a concept, reasoning, making decisions, using language and learning, could be regarded as the process of problem-solving [26-29]. In terms of the nature of cognition and meta-cognition, when people are encountering difficulties, they conquer problems by continuously recalling their prior knowledge and working on constructing former experiences recursively until they successfully solve the problems to develop higher order thinking. Thus, problem-solving relies on recalling the related prior experience, declarative knowledge and cognitive strategies [28, 30-34].

2) The Criteria of Ability of Problem-Solving

To summarize from literature review [34-36], the ability of problem-solving could be declared as having 1. the ability of detecting the problems, 2. the ability of identifying the problems, 3. the ability of making solutions, 4. the ability of making decisions, 5. the ability of implementing, 6. the ability of employing resources, and 7. the ability of monitoring solution process. However, the ability of implementing and employing resources demands higher order cognition and sophisticated skills for elementary students. Thus, in this study, we adopted the common situations in daily life as tests to examine and explore students’ performance of each aspect of problem-solving ability except implementing and employing resources.

3) The Process of Problem-Solving

Problem-solving has been a wide concern for a long time, and it draws discussions by researchers and educators to illustrate the process of itself. According to scholars [31, 37], the process of problem-solving could be summarized as seven steps: 1. problems finding, 2. problems verifying, 3. solutions making, 4. related information organizing, 5. resources distributing, 6. monitoring, and 7. evaluating.

4) The Teaching Strategies of Improving Problem-Solving

The process of problem-solving provides the rules for learners to solve the problems. In other words, teachers could provide the problem-based situation as teaching activities integrating the problem-solving process into teaching strategies to improve students’ ability. Based on instruction theories and research findings on problem solving learning, the points of teaching strategies have to inform learners of objectives, to create level of expectation for learning, to stimulate recall of prior learning to retrieve and activate short-term memory, to provide “learning guidance” to encode semantics for storage long-term memory, to elicit performance (practice), to respond to problems, to enhance encoding and verification, and to
provide feedback to reinforce and assess correct performance [38-41].

III. METHODOLOGY

A quasi-experimental research design was conducted in a medium school in northern Taiwan. Two classes of 3rd graders were randomly chosen, and the research period lasted for four weeks, three sessions per week. One of the two classes taught with “classified Social Bookmarking of network knowledge” was the experimental group; the other one taught with traditional method was the control group. Both of two classes adopted collaborative learning and grouped by S-shape grouping by means of the sum score of “Problem-Solving Test V1” (PST-V1) and the “Attitude Scale of Learning on Science” (ASLS). Before the research, a “Computer Competence Test” (CCT) was employed and the independent t-test as shown in table I shows that there is no significant difference of computer competence between two groups (t(56)=.919, p=.362>.05).

### TABLE I. THE T-TEST OF TWO GROUPS’ CCT

<table>
<thead>
<tr>
<th>F</th>
<th>Sig.</th>
<th>t</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.290</td>
<td>.043</td>
<td>.919</td>
<td>56</td>
<td>.362</td>
</tr>
</tbody>
</table>

The target theme of science course was “knowing animals”. Before the teaching, teacher gave the experimental group an overall introduction of the project-based inquiry learning and the instruction of how to manipulate with Moodle platform. Some required missions following up with teacher’s lecture to guide students to detect the problems, confirm the topics, make plans and carry out, sort the resources, have a presentation, and upload the data to internet, while the control group had teacher’s lecture including the introduction of animals, the body parts of animals, and the ecology of animals.

During the research, the “Assessment of Searching Information on Internet” (ASII) was employed to both groups to understand the performance of students’ information searching. After the class, the “Problem-Solving Test V2” (PST-V2) was employed to examine both groups of students’ problem-solving ability. The test results were examined by independent t-test to examine the difference of quantitative data. Students’ learning portfolios, teacher’s journal, and a semi-structured interview of students aiming on the situation of using classified Social Bookmarking were offered to assist as the qualitative data.

IV. INSTRUMENTS

Problem-Solving Test V1 (PST-V1) [42] including seven dimensions (problem detecting, factors of problem identifying, assessment of more information need, possible solution thinking, solution choosing, reasoning, and plan making) was adapted as four aspects: “problem detecting”, “characters of the problem identifying”, “assessment of more information need” and “solution deciding”. The raters gave the score by the exactitude of students’ answers. The deeper and more detailed the answer was described, the higher score raters would give. The coefficient of stability of PST-V1 is .908, and the reported range of the inter-rater reliability is between .719 and .293.

Problem-Solving Test V2 (PST-V2) [43] was modified according to the aspects included in the original test as four aspects as PST-V1, and the inter-rater reliability of PST-V2 is .91. Each of the items would be scored according to the completeness and reasonableness of students’ answers. The more complete and reasonable the answer was described, the higher score the raters would give. In the description of the answers, those who show more initiative and positive strategies would be scored higher than passive and relying on asking help.

The “assessment of Searching Information on Internet” (ASII) would cover the four main dimensions: 1. the basic knowledge of search engine, 2. finding out the URL of search engine, 3. searching the original URL , and 4. reading information and searching for answers.

V. RESULTS

The effect of using “classified Social Bookmarking of network knowledge” is described as follows.

A. The effect of using “classified Social Bookmarking of network knowledge” on “information sorting ability”

After the “assessment of Searching Information on Internet” (ASII) the independent t-test shows the experimental group outperformed than the control group statistically significantly on the overall performance of internet information searching (t(54)=6.867, p=.000<.05) as shown in table II, while the mean scores and standard deviation of experimental group and the control group are M=99.86, SD=.525; M=52.87, SD=36.204. The independent t-test of four dimensions of ASII as shown in table III also shows the experimental group is significantly different with the control group on basic knowledge of search engine (t(54)=4.975, p=.000<.05), finding out the URL of search engine (t(54)=3.431, p=.001<.05), searching the original URL (t(54)=5.974, p=.000<.05), and reading information and searching for answers (t(54)=7.642, p=.000<.05).

### TABLE II. THE T-TEST OF TWO GROUPS’ ASII

<table>
<thead>
<tr>
<th>F</th>
<th>Sig.</th>
<th>t</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>138.753</td>
<td>.000</td>
<td>6.867</td>
<td>54</td>
<td>.000*</td>
</tr>
</tbody>
</table>

B. The effect of using “classified Social Bookmarking of network knowledge” on “problem-solving ability”

The mean scores and standard deviation of “Problem-Solving Test V1” (PST-V1) which was conducted before the teaching of experimental group and control group are M=13.67, SD= 3.742; M=10.57, SD=4.032. The levene test of homogeneity as shown in table IV shows there is no significant deviation between these two groups (F=1.228, p=.274 >.05), and the independent t-test also shows these two groups have no
significant difference on the pretest of PST-V1 ($t(46)=2.748, p=.309>.05$). In addition, each of the four aspects under PST-V1 (as shown in Table V) shows no significant difference between the two groups, problem detecting ($t(46)=3.261, p=.202>.05$), characters of the problem identifying ($t(46)=1.417, p=.163>.05$), assessment of more information need ($t(46)=.235, p=.815>.05$), solution deciding ($t(46)=2.831, p=.507>.05$).

The mean scores and standard deviation of “Problem-Solving Test V2” (PST-V2) which was conducted after four weeks teaching of experimental TABLE III. THE T-TEST OF TWO GROUPS’ FOUR DIMENSIONS OF ASII

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>F</th>
<th>Sig.</th>
<th>t</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic knowledge of search engine</td>
<td>5.13</td>
<td>.019</td>
<td>3.26</td>
<td>46</td>
<td>.001*</td>
</tr>
<tr>
<td>Finding out the URL of search engine</td>
<td>3.98</td>
<td>.049</td>
<td>2.43</td>
<td>46</td>
<td>.019*</td>
</tr>
<tr>
<td>Searching the original URL</td>
<td>1.12</td>
<td>.233</td>
<td>.77</td>
<td>5</td>
<td>.447</td>
</tr>
<tr>
<td>Reading in information and searching for answers</td>
<td>117.40</td>
<td>.000</td>
<td>117.40</td>
<td>46</td>
<td>.000*</td>
</tr>
</tbody>
</table>

TABLE IV. THE T-TEST OF TWO GROUPS’ PST-V1

<table>
<thead>
<tr>
<th>Test</th>
<th>F</th>
<th>Sig.</th>
<th>t</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PST-V1 (pretest)</td>
<td>1.22</td>
<td>.274</td>
<td>2.74</td>
<td>46</td>
<td>.309</td>
</tr>
</tbody>
</table>

TABLE V. THE T-TEST OF FOUR ASPECTS UNDER PST-V1

<table>
<thead>
<tr>
<th>Test</th>
<th>F</th>
<th>Sig.</th>
<th>t</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem detecting</td>
<td>2.63</td>
<td>.112</td>
<td>2.63</td>
<td>46</td>
<td>.004*</td>
</tr>
<tr>
<td>Characters of the problem identifying</td>
<td>3.06</td>
<td>.088</td>
<td>3.06</td>
<td>46</td>
<td>.002*</td>
</tr>
<tr>
<td>Assessment of more information need</td>
<td>3.60</td>
<td>.287</td>
<td>3.60</td>
<td>46</td>
<td>.000*</td>
</tr>
<tr>
<td>Solution deciding</td>
<td>2.86</td>
<td>.147</td>
<td>2.86</td>
<td>46</td>
<td>.001*</td>
</tr>
</tbody>
</table>

TABLE VI. THE T-TEST OF TWO GROUPS’ PST-V2

<table>
<thead>
<tr>
<th>Test</th>
<th>F</th>
<th>Sig.</th>
<th>t</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PST-V2 (post-test)</td>
<td>5.44</td>
<td>.024</td>
<td>2.99</td>
<td>45</td>
<td>.004*</td>
</tr>
</tbody>
</table>

TABLE VII. THE T-TEST OF FOUR ASPECTS UNDER PST-V2

<table>
<thead>
<tr>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>.001*</td>
</tr>
<tr>
<td>.006*</td>
</tr>
<tr>
<td>.287</td>
</tr>
<tr>
<td>.019*</td>
</tr>
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</table>

VI. DISCUSSION

This study explore students’ information sorting ability and problem-solving ability on the effect of two different approaches, “using classified Social Bookmarking of network knowledge” and “using traditional teaching” on science course. The results show there are positive effects using classified Social Bookmarking of network knowledge on their information sorting ability. These abilities include four dimensions: basic knowledge of search engine, finding out the URL of search engine, searching the original URL, and reading information and searching for answers.

The result implies that students built an information organizing model by using classified Social Bookmarking of network knowledge to assist project-based inquiry learning. The internalized model starts from information group and control group are $M=13.74$, $SD=1.790$, $M=11.14$, $SD=3.461$. The independent t-test (as shown in Table VI) shows the experimental group outperformed than the control group significantly ($t(45)=2.999, p=.004<.05$) after teaching with classified Social Bookmarking of network knowledge to assist project-based inquiry learning.

Three of four aspects under PST-V2, problem detecting ($t(45)=2.236, p=.030<.05$), characters of the problem identifying ($t(45)=2.884, p=.006<.05$), solution deciding ($t(45)=2.482, p=.019<.05$), show significant difference between two groups, whereas the aspect of assessment of more information need shows insignificant ($t(45)=1.077, p=.287>.05$).
needs, clarifying main topic, searching keywords, browsing, selecting, reading, searching for solutions, tags recording as bookmarks, classifying, and uploading to share. Through the process of the mechanism, students would be able to decrease the load of browsing from messy data and save the time to dig in inquiry learning [6]. Thus using classified Social Bookmarking of network knowledge to assist project-based inquiry learning has the positive potential to enhance students’ higher order computer competence of resources application [44-45].

Besides, the result shows using classified Social Bookmarking of network knowledge to assist project-based inquiry learning improved students’ ability of problem-solving including “problem detecting”, “characters of the problem identifying”, “solution deciding”.

Nevertheless, on the aspect of “assessment of more information need”, the independent t-test doesn’t show statistically significant difference between two groups while both groups have lowest mean scores among the four aspects. Students answered the questions with surface explanation instead of exploring in depth. This implies that 3rd graders are still not competent to assess whether the information on hand is sustainable due to their mental development, which needs more practice of higher order thinking.

Information technology is actually a tool of problem-solving, as well as a tool of collaborative learning. Integrating classified Social Bookmarking of network knowledge into science learning can extend the maximum function of information technology into education [46].

Working with the internet technology enables the students to collect the data according to their plans aiming to the topic to help them build up problem-solving strategies and skills integrating with their prior knowledge [47] and develop independent thinking.

REFERENCE


