



Examining the Effects of MOOCs Learners' Social Searching Results on Learning Behaviors and Learning Outcomes

Yu-Sheng Su & Chester S.J. Huang
National Central University, Taiwan (R.O.C.)
Ting-Jou Ding
MingDao University, Taiwan (R.O.C.)

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MOOCs social media has appealed to most instructors and learners like strong magnets by using ubiquitous handheld devices to share and discuss films, pictures, and messages. Through the social platform, users can share, track, and search for the information of their specific interests. Thus, they can make interactive discussions as well as social learning on multimedia texts and learning materials. It provides teachers and students the social platform to express opinions or ask questions. We developed an assistant system to help students evaluate problems and solutions is an emerging issue, and the MOOCs social searching system is a key solution. We report a case study that focuses on MOOCs learners' social searching results and its influence on learning behaviors and learning outcomes. A case study was carried out with 36 high school students in Northern Taiwan. Results show that the mechanism benefits student information gathering and improves learning performance.

Keywords: MOOCs, social media, social search, learning analytics

INTRODUCTION

MOOCs social media has appealed to most instructors and learners like strong magnets by using ubiquitous handheld devices to share and discuss films, pictures, and messages. Recently, most researches explore the efficacy of using MOOCs social media platforms as pedagogy. It not only enhances the communication and interaction between instructors and learners, but that between learners themselves. Through the social platform, users can share, track, and search for the information of their specific interests. Thus, they can make interactive discussions as well as social

Correspondence: Yu-Sheng Su,
Research Center for Advanced Science and Technology, National Central University,
Taiwan (ROC).
E-mail: addison@csie.ncu.edu.tw

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learning on multimedia texts and learning materials. It provides teachers and students the social platform to express opinions or ask questions.

Web search systems have replaced the library as the major source of information for students (Cromley & Azevedo, 2009; Lenhart, Arafeh, Smith, & Macgill, 2008; Kuiper, Volman, & Terwel, 2005). However, some studies indicated that although students may feel confident when using Web search, most students still lack basic search processes and search abilities (Fidel, Davies, Douglass, Holder, Hopkins, & Kushner, 1999; Lorenzen, 2001; Pritchard & Cartwright, 2004; Schacter, Chung, & Dorr, 1998; Shenton & Dixon, 2003). Moreover, Web search systems commonly used by students, such as Google, Bing, and Yahoo, are all designed for single users working in an independent environment. With this Web search workflow, it is difficult for students working in a group to collaborate for seeking information, and students can rely only on their own search experience to explore potential solutions when they encounter difficulties with Web search (Hansen & Jarvelin, 2005). Walraven, Brand-Gruwel, and Boshuizen (2009) performed a more in-depth experimental observation regarding this question and found that students spend the most time understanding problems and exploring potential solutions when using Web search. The time a student spends in finding potential solutions seems highly related to search processes and abilities.

To address this issue, Kuiper, Volman, and Terwel (2009) performed an experimental observation collaborative inquiry activity between the teacher and students, in which students discussed their search questions and improved learning results through social media group. Students had the opportunity to tell the teacher about the search problem during the activity. According to Kuiper et al. (2009), this collaborative inquiry activity not only improves students' search processes but also increases their outcome for solving problems by sharing materials and learning results with each other. Chen (2010) has presented that students' MOOCs learning behaviors have a significant positive correlation with social searching results.

Social search can be classified into two major sub-topics: implicit collaboration and explicit collaboration (Golovchinsky, Qvarfordt, & Pickens, 2009). One important characteristic of implicit collaboration is the type of system using the information filtering technology to help user's organization search data. Information filtering approaches have been applied to the development of social searching systems for several decades (Chu, Hwang, Tsai, & Chen, 2008). To develop social search for improving the search processes and abilities of students, it is critical to understand how human knowledge can be simulated by a computer system. Most social searching systems perform information filtering by eliciting knowledge from domain knowledge areas. A classic example is a collaborative filtering system, which

State of the literature

- According to previous studies in the literature, researchers found that most students lack adequate search processes and search abilities when using Web search.
- The literature points out that there is a need to integrate the MOOCs social searching technology with the teaching and learning practice to improve learners' learning performance.
- The use of MOOCs teaching strategies can be utilized to sustain the process of learning. Several reviews published in this decade have indicated that social searching search is gradually becoming an integral part of the classroom.

Contribution of this paper to the literature

- This study explores the relationship between learners' learning behaviors and learning performance, and a great feature of the social searching system, the whole class' response results aggregated by learning activities with educational data.
- This study shows the findings that MOOCs social search benefits student information gathering and improves their learning performance. In addition, MOOCs social searching works as an instructor to assist students in enhancing their learning interaction.
- Implications for MOOCs learning strategies and social media technological development with MOOCs social searching systems are discussed.

attempts to compute a similarity score to seek people sharing a similar search task. Thereafter, it helps users filter the searching results, and suggests possible answers according to their click or query history.

Explicit collaboration research is history-enriched environments. History-enriched environments are open information environments that allow every user to browse other users' search information. With these information records, users can easily find important or frequently used information items of society. A famous system was Footprint (Wexelblat & Maes, 1999), which uses many simple figures, called footprint, to show users information retrieval for group situation. The collaborative filtering technology and the history-enriched environment have recently been combined with social information access technologies. They are also called social search and social navigation (Freyne, Farzan, Brusilovsky, Smyth, & Coyle, 2007). VisSearch (Lee, 2005) and KnowledgeSea II (Brusilovsky, Chavan, & Farzan, 2004) were two systems applied to college education. VisSearch provides college students with a visualized search interface. The system automatically makes the search processes and shows search results or documents, which their classmates use and might need. KnowledgeSea II collects annotations and reading information of the same class students to help them find important learning materials quickly. Freyne et al. (2007) established a collaborative Web search framework (CWS) that contained two parts. CWS is a remarkable social searching system that can support searching and reading activity to solve the information problem. On the other hand, one important characteristic of explicit collaboration is the type of system used by a group of users that have a common information goal or search task. Unlike implicit collaboration, an explicit collaboration system allows users to divide their search tasks and help each other by communicating and information sharing. Hansen and Järvelin (2005) defined collaborative information retrieval (CIR), which emphasized the importance of human collaboration and linked communication with search processes.

Based on previous studies, we developed a MOOCs social searching system to elicit and organize knowledge and experiences regarding problem solving processes from students. MOOCs social searching system is then employed to advise individual students to enhance their search processes and search abilities on MOOCs social media and Internet. The study reports a case study that focuses on MOOCs learners' social searching results and its influence on learning behaviors and learning outcomes. We conducted the case study lasting 4 months with 36 high school students in Northern Taiwan, observing the influence of MOOCs social searching results on students' learning behaviors and learning performance. A series of experimental stages such as the data collection, data analysis and interview revealed how MOOCs learners' social searching system benefits the information gathering function of students and improves learning performance.

SOCIAL SEARCHING SYSTEM

Figure 1 is the interface of social searching system, which contains a search window, group history, search suggestion, web annotation tool, and a discussion room. Comparison with pervious social searching systems, these functions satisfy users to divide their search tasks and help each other by communicating and information sharing. When a student logs into the system, he/she can see his/her present collaborators in the group member window on the left side. The group member window shows who is searching for the same task and whether a group member is online or offline. A student can select a group member and talk to him/her using text messaging in the discussion room. The communication function is used to determine the search job, ask for help, or report an information finding. All



Figure 1. The social searching system
 (a) Search box and keywords suggestion (b) Group members and search history (c) Discussion room (d) Annotation toolbar, rate, and enter your comments (e) Browse your search information

text messages are kept on the server, enabling offline collaborators to join the discussion. The discussion history is sent to their message window when they login.

After a student decides on a search task, he/she easily starts the search using the search box on the top of left. Search engine choices include Facebook, Google, Yahoo, and Bing. Different students can use a different search engine to expand the search area and reduce the likelihood of everyone finding only the same documents. Searching results show in the browser on the right side. The search processes of the group are aided by keyword suggestions. The system shows the six most frequently used search queries below the search box. Moreover, students can learn what search words other members usually use to perform the same or similar search. When he/she clicks a suggested query, the system repeats the search for him/her. The system also tries to auto-complete their typing query using the group search history. Furthermore, they can more easily pick a suitable search query.

All annotations from each student are shared with the whole group to meet awareness requirements. When a student opens a web document, the annotation list of the left side shows him/her the entire annotation history that collaborators have made. If a page contains highlighting, the highlighted text is shown in the browser. Finally, the system summarizes the search processes of collaborators to a group search result summary. The summary contains all documents students have annotated. The list is ranked according to rating results and the number of highlights; thus, students can quickly find useful pages for the search topic. They can see all search results of each group member and use the results to finish the task of information processing and organization.

METHODOLOGY

Participants

This study chose a case study of student information activities in a senior high school (16-18 year olds). Thirty-six students (thirty-one male and five female) and

one male teacher from a class on computer participated in the study. Thirty-six students were randomly divided into nine groups, and one teacher from a class on computer networks participated in the study. We have indicated that the number of members in a group could affect students' learning abilities when working in social media and MOOCs environment (Johnson & Johnson, 1984). Prior research found that a group consisting of three to six members is appropriate for learning (Dillenbourg, 1999; Gros, 2001; Johnson, Johnson, & Smith, 1998). Therefore, in this experiment, each group consisted of four members. The teacher periodically assigned students some work problem and asked them to find the solution. The experiment was conducted from August to December in 2014.

Before starting the experiment, a limited general biographical study was done on all participating students. The biographical study included the educational background, computer abilities, and Internet search experience of each student. Only 32% of the students said they had taken formal training for longer than one year in Web searching systems. Most students did not have good information training prior to this study. 45% of the students had used a computer for more than five years, and 9% had more than ten years' experience in using a computer. About 12% of the students had used a computer for less than three years and 3% had almost no prior computer experience. We found that student Web search experience is less than their computer experience. Most students had used Web search for 3 to 5 years. Approximately 15% of students had two years or less experience using Web search, whereas most students had some computer and Web search experience.

Procedures

Students from the selected course met Friday mornings in a computer classroom and focused on computer networks. The course schedule and progress were mainly decided by the teacher. Case study arrangements were made during the first week. We gave each student a questionnaire for the biographical study.

First, students were instructed to search the work issue using Web search. Each group was assigned a search assignment on computer networks. A search assignment comprised 20 questions that students had to explain. These questions were modified from those used by Tseng, Hwang, Tsai, and Tsai (2009). Questions were considered knowledge-finding questions, which were evaluated by experts based on the correctness, richness, and completeness of the answers. For example, for a search assignment of "computer virus," a group had to find answers to questions like "What is a computer virus?" "How many classifications are computer viruses categorized?" "How do you prevent a computer virus?" A knowledge-finding question requires gathering information and provides a summary regarding relevant knowledge. Students searched for potential solutions on Internet and were required to record latent solutions in a search diary. At Week 10, students took their group search report and diary as a pre-test.

During Week 11, we introduced the MOOCs social searching system and gave students one hour to practice using the software. Subsequently, each student was interviewed for five minutes to obtain opinions about the system. Every group was assigned to use the MOOCs social searching system for nine search activities given during Weeks 11 to 19. Each search activity was conducted as the assignment. Every group was assigned to use the MOOCs social searching system for nine search activities given on post-test. Each search activity was conducted as the assignment. In each week, students were scheduled to use the MOOCs social searching system to learn for one period (i.e., 50 min); that is, pre-test and post-test spent the same amount of time using collaborative search. A search assignment comprised 20 questions that students had to explain. These questions also were modified from those used by Tseng, Hwang, Tsai, and Tsai (2009). A diary and the group search

report were handed for each group search assignment. During Week 20, students gave a presentation on their final group search activity. They took their search results, shared reflections, described search processes and the MOOCs social media situation as the post-test. The teacher gave each group a grade based on their presentation, group search report, and post-test.

Data collection

The search diary was the main tool for tracing the search record of each group. The diary was a semi-structured questionnaire with multiple questions based on the IPS model (Brand-Gruwel, Wopereis, & Walraven, 2009). The IPS model describes the idea required to understand problems and find potential solutions when the Internet is used to search for information. The five constituent processes "Define information problem," "Search information," "Scan information," "Process information," and "Organize and present information" are linked blocks.

The define information problem is always performed at the beginning of a process. This process is important to obtain clear insight into a problem (Hill, 1999; Land & Greene, 2000; Moore, 1995). Without a good problem definition, the problem becomes difficult to solve, and answers may be inadequate. Executing search information means specifying precise search terms and assessing Web sites. The precise search term is a key factor. A term is entered into collaborative search, which then returns a list of titles and short comments on possible relevant sources. The search results must be assessed for quality, relevance, and reliability (Wopereis, Brand-Gruwel, & Vermetten, 2008). The site that is opened after a search is scanned (scan information) to assess the type of information and whether it is useful. While scanning information, a user can elaborate on the content and combine the information with previous knowledge. When the information is deemed useful, it can be stored and shared using MOOCs social search. In contrast with scanning information, processing the information entails in-depth processing. The goal of process information is to gain a deep understanding of the information (Schmeck & Geisler-Brenstein, 1989) and integrate the different pieces of information with relevant previous knowledge (Wopereis et al., 2008). The process of organizing and presenting information concerns the synthesis of relevant information into cogent, productive uses.

Students answered questions regarding the MOOCs social searching and collaboration, the processes of solving problems, and the discussion behavior in their group activity. The diary also contained empty fields for students to record any information they desired, such as recording difficulties they encountered searching the Internet, providing feedback regarding use of the social searching system, or describing group mistakes. The students were asked to submit their diaries at the end of each activity.

In addition to the search diary, the system log was a very good source of information. The log contained data about search queries, annotation records, and sharing time and frequency for each group. These records helped researchers understand the social searching behavior of students.

All students were individually interviewed during the final week. The interview was conducted in a separated area of the classroom in a one-on-one informal environment. We asked questions designed to let the students talk freely on their opinions regarding group search activities of Web search and group search activities on MOOCs social search. The whole interview was audio recorded. The teacher provided class grades and group search reports to researchers at the end of the experiment.

Data analysis

Analysis of search processes

An inductive-deductive method was used to develop the coding tool for analyzing the search diary. The coding process pertained to reformulated main processes and their sub-processes. The “define information” included (a) reading a task, (b) formulating questions, (c) activating prior knowledge, (d) clarifying task requirements, and (e) determining the required information. The “search information” involved (a) specifying search terms and (b) evaluating the search result. The “scan information” included (a) reading global information, (b) evaluating the information source, (c) storing relevant information, and (d) elaborating on content. The “process information” contained (a) reading text in depth, (b) evaluating the source and information, and (c) elaborating the content. The “organize and present information” included (a) formulating a problem, (b) structuring relevant information, and (c) elaborating on content. This study is scored the search process by using the scoring tool. The raters scored the five patterns again, using a five-point Likert scale. By using this scale an overall picture of the search processes was obtained. A score of 1 was given when a pattern did not occur, and a score of 5 was given when a pattern was obvious. A rating form has been developed to assess pre- and post-test search processes. The form consisted of 18 items, classified into four categories: the structure of the argument (5 items), the quality of the content (8 items), the style of content (4 items), and the layout (1 item) were scored using the categories “yes” or “no” (from 1 = *totally disagree*, to 5 = *totally agree*).

Analysis of search abilities

Concerning search abilities of MOOCs social search, this study took a careful look at the post-test and decided the group score given by the teacher. The experiment used a coding procedure designed by Kuiper (2009) to measure the search abilities of each group. However, this study modified some code methods because the experiment environment differed from that of Kuiper (2009). The form is used to assess the adequacy the searching abilities of students within the context of that specific assignment. Search abilities may concern three aspects of student search activity: T = typing a word or a couple of words to search. C = clicking and scanning a specific web text. R = reading activities involves more than identifying a text. All search abilities receive the score 0, 0.5 or 1, depending on the adequacy (or relevance) of that activity in the context of a specific assignment. Score 0: The activity is irrelevant for completing the assignment and does not contribute to finding the right answer; this category also contains ‘non-actions’ such as skipping a relevant text on a website in which the answer may be found. Score 0.5: The activity is somewhat relevant for completing the assignment; it might contribute to finding the right answer. Score 1: The activity is relevant for completing the assignment; it contributes to finding the right answer. In this manner, an overall score for each student in using typing, clicking, and reading abilities was calculated.

Analysis of learning behaviors and learning outcomes

The success of MOOCs social media learning behaviors and learning outcomes requires the constant generation, transfer, and understanding of knowledge, thus rendering collaboration an essential and highly valued process. Moreover, social searching behaviors might enrich student’s learning experience by motivating them to seek new insights and perspectives (Hwang & Kuo, 2011). We used the system log and post-test to determine the relationship between their social searching behaviors

and learning outcomes. The system log included sharing time and frequency for each group. Sharing frequency is the total amount that group members used the MOOCs social searching system to share or recommend their search results with others, measured using the system log. The teacher assigned each group a search outcome grade based on their sharing frequency and sharing content. Therefore, the search behavior is a subjective judgment of their group collaborative situation based on sharing frequency. If members of a group showed a tendency to use collaborative functions to discuss and help one another, the search behavior of the group was identified as "Collaborative." Alternatively, if members of a group showed a tendency not to use collaborative functions, the behavior was identified as "Individual."

RESULTS

MOOCs social searching results influence on learners' search processes, search abilities, and learning outcomes

One important research problem in our study was the influence of MOOCs social searching system on learners' search processes and search abilities. We used the pre-test and post-test to determine the relationship between their search processes. Table 1 shows the means and the standard deviations for the number of times constituent processes were performed by the 36 students. The result indicates a significant difference between the pre-test and post-test in the four processes of search information, scan information, process information, and organizing and presenting information. However, the define information problem had no significant difference between the pre-test and post-test ($t = -1.94, p < .05$). The reason is that they already understood that the first sentence of each problem of a topic is critical. Comparisons of the students in search information and scan information revealed substantial differences between the pre- and post-tests. A closer observation of the data reveals that the students used more attention between search and scan information, meaning that they clicked on a link faster in Internet search and, after looking at the website, quickly decided to return to Web search and click on another link. We observed significant differences between the pre- and post-tests for "Search information" ($t = 5.68, p < .05$), "Scan information" ($t = 6.04, p < .05$), "Process information" ($t = -5.29, p < .05$), and "Organizing and presenting information" ($t = -2.63, p < .05$).

Another result show a significant difference for search abilities between the pre-test and post-test. Table 2 shows that the results present a significant difference for search abilities between the pre-test and post-test. Furthermore, the typing ability of the post-test was significantly better than that of the pre-test ($t = -9.65, p < .05$). The purpose of the test was primarily to examine students' keyword adoption in search processes after using the collaborative search system, that is, the number of

Table 1. Paired-samples t-test for search processes between the pre-test and post-test

Item	Mean	N	SD	SEM	t	df	Sig. (2-tailed)
Define	2.13	36	0.91	.16	-1.94	31	.062
Information Problem	2.63	36	1.21	.21			
Search	12.81	36	3.85	.68	5.68	31	.000*
Information	8.97	36	2.86	.50			
Scan Information	17.59	36	2.95	.52	6.04	31	.000*
	12.91	36	3.55	.63			
Process	7.03	36	2.18	.38	-5.29	31	.000*
Information	11.41	36	3.86	.68			
Organize and Present	20.44	36	5.00	.88	-2.63	31	.013*
Information	24.09	36	5.82	1.03			

keywords adapted than in the post-test compared with the pre-test, after using MOOCs social search. Moreover, the empirical results also revealed a significant difference between the pre- and the post-tests.

The clicking ability of the post-test was significantly better than that of the pre-test ($t = -9.70, p < .05$). The test was measured by computing the accuracy ratio of the students' clicking pages. When the students searched for information on Internet, they were required to retrieve information from the searched web pages by using a limited number of words. Thus, the accuracy ratio of clicking pages in the search processes of the corresponding questions was calculated according to the word limit. For the students in the post-test, their usage of keywords and accuracy ratio of clicking pages had both made obvious improvements. They could also quickly find accurate answers from just a few web page using important keywords.

Finally, the reading ability of the post-test was significantly better than that of the pre-test ($t = -10.35, p < .05$). The purpose of the test was to measure one's efficiency while assessing the first Web site after browsing all the searched pages displayed on the browser. This can act as a reference to understand a student's assessment in determining the first related web document. According to the statistics results, the mean of the post-test was higher than that of the pre-test, implying that the students improved their reading ability after employing MOOCs social search. In the process of selecting which web site or facebook group to browse, the students were able to read the description of each candidate site shown on the annotation list and search result summary of the MOOCs social searching system.

One important research problem in our study was the influence of MOOCs learners' social searching results on sharing behavior and post-test. Table 3 shows sharing frequency and outcome of each group in the post-test. Groups with a higher sharing frequency produced better learning outcome than the groups with a lower sharing frequency. To understand the reason for the difference, we observed the detailed system log of the two clusters in the post-test. At the beginning, there were no obvious differences in the search activities between the two clusters. However, as search activities progressed, the high score cluster converged toward the high score actions while the search activities of the low score cluster remained random. For example, the search task "Explain the OSI layer in network architecture" showed

Table 2. Paired-samples t-test for search abilities between the pre-test and post-test

Item		Mean	N	SD	SEM	t	df	Sig. (2-tailed)
Typing	Pre-test	0.40	36	0.14	0.02	-9.65	31	.000*
	Post-test	0.70	36	0.14	0.02			
Clicking	Pre-test	0.40	36	0.13	0.02	-9.70	31	.000*
	Post-test	0.67	36	0.10	0.02			
Reading	Pre-test	0.47	36	0.11	0.02	-10.35	31	.000*
	Post-test	0.74	36	0.11	0.02			
Average Score	Pre-test	0.42	36	0.09	0.02	-13.70	31	.000*
	Post-test	0.70	36	0.08	0.02			

* Correlation is significant at the 0.05 level ($p < .05$)

Table 3. The post-test scores and sharing frequency

Group	The frequency of sharing	Post-test
1	184	0.87
2	78	0.56
3	96	0.49
4	88	0.6
5	102	0.65
6	86	0.6
7	70	0.55
8	220	0.84
9	154	0.76

that students in each cluster all used search keywords from the assignment like "OSI", "Layer" and "Network" to query the Internet and then modified their search query based on returned documents to expressions such as "TCP/IP" and "Network protocol." Most students in clusters with a high search score focused on several highly precise keywords or expressions such as "What are the OSI model and seven layer" or "Physical layer and data link layer" for their search. However, students in the low search score cluster still used low related keywords like "802.2", "UDP", or "IP protocol" and the queries between each member were very different.

Interviews

We examined all the observation records from system log and interviews to find possible influences of MOOCs social searching results on students' learning behaviors and learning outcomes.

a) MOOCs social search lets students sharing the MOOCs teaching and learning strategy.

One major change of MOOCs social search is that the group can divide difficult problems and share relative solutions. Contrasted to the Web search environment, a student does not need to comprehend the entire search strategy by himself/herself. Students can fully collaborate in the search task. For example, a student can roughly search the information and assign the refining work of scanning and processing to other members. A learner can also easily take over a past search process or start a search based on the search results of others.

"When I was away from home, I would call my classmate to search the information I wanted. Then I could just see what my classmate found for me when I returned home and open the software."

"Then I look at the group summary before starting the search. If the information I wanted was there, I might not do the search again. I could see the related web documents by my classmates and try to find the answer."

Consequently, the MOOCs social searching mechanism sharing enables students to spend less time finishing their learning work.

b) MOOCs social search enables group leader to assist other members in understanding problems and finding potential solutions.

The convenience of MOOCs social search also benefits group management in the search activities. It is a difficult job for a group leader to monitor the search process of each student in his/her group. The MOOCs social searching system assists group leaders by showing the search process of all group members. Consequently, group leaders can trace the search process of other members and assign their search task. A high search outcome student usually plays the role of leader to demonstrate how he/she understand problems and find potential solutions by defining the information problem, searching for information, scanning, processing, and organizing the information.

"The tool enabled me to control the work situation of my group member. I watched their search results to see what had been done. If I found that they forgot to do something, I could keep them on Internet."

c) MOOCs social search enables student to quickly organize their learning tasks.

In the interview, nearly every student mentioned the benefit of MOOCs social search for data management and information organization. The annotation and auto-summary functions provided easy access to their information findings at anytime. Students made annotations to mark possible answers and useful web documents while they searched. Thus, they did not worry about how to find necessary data for organizing their search reports.

“I like the tool. I can highlight important content in the web document and quickly find it the next time I open the document.”

“I think the annotation is a very convenient function. I do not need to keep the addresses of the Web sites anymore. I just click the rating button and the document shows in the list of my group summary.”

“The annotation is important for our cooperation. We usually watch the group summary and obtain the answer highlighted by our group members when we organize the search result of our group.”

MOOCs social search saved considerable search time because students did not waste time seeking previous information and reread the materials. The system also helps students quickly manage their search tasks.

CONCLUSION AND DISCUSSION

This study examined the influence of MOOCs social searching results on learners' searching processes, searching abilities, and learning outcomes. A four-month case study observed actual class activities of groups of students in solving their information problems. We investigated the information background of students and let them search the Internet as a group in two different ways. One way was using Web search; the other was using MOOCs social search. We observed the difference between the two kinds of activities to determine the influence of MOOCs social searching results on learning behaviors and learning performance. Experimental results indicate that MOOCs social search improves the search processes of students and raises search abilities and students' search outcomes.

First, MOOCs social search enables students to share their problem solving processes through discussion and collaboration within the social group. The system helps students divide difficult problems into sub-tasks and simplify the procedure of processing Internet information. Students can exchange information and find possible search answers. They can also get needed assistance and help other group members finish search tasks. The results of the current study are similar to the observations of Hyldegård (2006) in a group class environment. Moreover, A high search outcome student usually plays the role of leader to demonstrate how he/she solves problems by defining the information problem, searching for information, scanning, processing, and organizing the information, during which the middle search outcome and low search outcome members can observe and reflect. Thus, the middle search outcome and low search outcome members are allowed to question the high search outcome peer at any time when conducting problem solving (Lee, Hsieh, & Hwang, 2011; Hwang & Kuo, 2011; Hwang, Chen, Tsai, & Tsai, 2011; Tseng, Hwang, Tsai & Tsai, 2009). The collaboration has an important effect on the learning performance of students.

Second, MOOCs social search improves the problem solving abilities of students. The function of sharing search results automatically increases the number of learning materials that are found in each group. Using MOOCs and social collaboration helps students focus the search task on the class problem and learn the search strategy from other group members. This system utility is like the collaborative inquiry activity of Kuiper (2009). In addition, the MOOCs social searching system reduces the heavy load of teachers and extends their flexibility for observing the collaboration of students in activities.

Third, MOOCs social search records the team search result and allows students to trace their search processes easily. The leader of the group can monitor the work status of each member and allocate search tasks. Most students used this function to monitor their search processes and increase their cooperation efficiency.

The last effect is information organization of the student. Most students indicated that they did not need to browse the same document repeatedly in order to find the

answer in their search activity. MOOCs social search lets each group member access search results anytime and even search multi-targets at the same time.

By evaluating the influence on the learning behavior of students, those groups that used MOOCs social search had a better search outcome and correctness than those groups that used Internet search. MOOCs social search encourages students to learn better search strategy from their group collaborators and revise their own search processes.

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