

The effect of collaborative annotation on Chinese reading level in primary schools in China

Xianmin Yang, Shengquan Yu and Zhong Sun

Xianmin Yang is a PhD candidate at the Institute of Modern Educational Technology at Beijing Normal University. His main research interests are technology-enhanced learning, design of learning resource in ubiquitous learning environment and corporate e-Learning. Shengquan Yu is a professor at the Institute of Modern Educational Technology at Beijing Normal University. His main research interests are integration of information and communication technology (ICT) and teaching, ubiquitous learning, blended learning and development of learning management system. Zhong Sun is a lecturer at the College of Information Engineering at Capital Normal University. Her main research interests are integration of ICT and teaching and ICT-based instructional design. Address for correspondence: Mr Xianmin Yang, Institute of Modern Educational Technology, Room 215, Yanbo Building, Beijing Normal University, 19 Xijiekouwai Street, Beijing 100875, China. Tel: +86 18901373840; Fax: +86 10 58800256; email: yangxianmin8888@163.com

Abstract

As school networks get more available, reading instruction in a computer classroom has become more and more popular in China. Although information and communication technology (ICT) has brought about some improvements in classroom teaching, it must be admitted that the phenomenon of fast reading with low-level cognitions is threatening school children's reading literacy. In order to address this problem, a collaborative annotation tool called Sharing Unique Reading Feeling (SURF) was developed for creating and sharing annotations. This study explored SURF-based collaborative reading instruction, and investigated the effect of collaborative annotation supported by SURF on primary school students' Chinese reading levels with methods of equal group experiment, interview and comparative analysis. Finally, some suggestions were proposed for the development of instructional annotation tools and the implementation of current reading instruction especially in computer classrooms. Results showed that the collaborative annotation supported by SURF could promote students' reading performance, enhance their Chinese reading levels in primary schools, and it was also helpful to develop the higher-level cognitive abilities such as analyzing, summarizing and evaluating.

Introduction

With the rapid development of information and communication technology (ICT), various handheld devices are becoming widely popular and accessible. Reading virtually happens anytime and anywhere. Nevertheless, studies have found that reading on these handheld devices focuses on surface reading (Best & Marcus, 2009; Cai & Tang, 2007; Ding, 2006). Surface reading is considered as reading with low-level cognition and aims at entertaining (Cai & Tang, 2007). In the reading process, people often read fast but do not understand the contents deeply. It goes against the improvement of people's reading literacy. On the other hand, deep reading means a sophisticated processing of contents and includes reasoning, critical analysis, reflection and insight (Scherer, 2009). Deep reading can help foster reading comprehension and turn into deep learning (Roberts & Roberts, 2008).

Practitioner Notes

What is already known about this topic

- Annotation could improve students' reading and writing.
- Annotation could enhance reading comprehension.
- Full annotation sharing could improve learning outcome.
- Reading passages with hypermedia annotations significantly benefited passage comprehension and vocabulary.

What this paper adds

- Collaborative annotation could enhance Chinese reading levels in primary schools of China, and is very helpful in addressing the issue of surface reading in Chinese class.
- Collaborative annotation is also helpful to develop higher-level cognitive abilities such as analyzing, summarizing and evaluating.

Implications for practice and/or policy

- Collaborative reading assisted by annotation tool should be given profound attention and be applied more generally.
- Collaboration is rather significant in developing students' reading literacy, but abuse of collaboration will be a waste of time and will not get good effect.
- Do not lose the dominant role of teachers, because excessive freedom for students will result in failure in achieving teaching objectives.
- Some competition activities (eg, setting up Reading Stars, giving little and red flowers) should be provided to inspire students to do annotating passionately and seriously.
- The Ministry of Education in China should actively encourage Chinese teachers in primary and secondary schools to implement annotation reading instruction in computer classrooms.
- Some wonderful annotation tools just like SURF should be developed and generalized in a larger scope supported by the government.

In China, unfortunately, primary and secondary school education have been influenced by the tide of social surface reading. The phenomenon of surface reading is affecting Chinese instruction and the formation of the students' minds, attitudes and values (Xu, 2009). Marshall (1997) proved that annotations could improve the process of reading as well as the reader's comprehension of text. You (2009) indicated that annotation reading could promote interaction between students and texts. Fu (2009) believed that implementing annotation reading instruction could stimulate the students' interests and improve their reading confidence and literacy. Given the advantage of annotation reading, meanwhile, in order to solve the problem of surface reading and identify the real effect of annotation on students' reading, much work has been done. The literatures on annotation reading in China and abroad are reviewed as follows.

Research of annotation reading in China

Since 2001, the national Chinese curriculum reform, which points out carrying out annotation reading supported by ICT in elementary education clearly, has been carried out all over China. In recent years, quite a few Chinese researchers have studied annotation reading instruction in the classroom. Yang (2008) and Liu (2010) introduced how to develop students' reading personality in annotation reading. Yang and Yang (2008) presented a few electronic annotation tools, like

iMarkup, Diigo, HWPRO, Foxit Reader etc., in reading instruction. Besides the above, some research focused on social annotation technology and its application in educational contexts (Chang, Chen & Zhang, 2009; Jiang, 2009; Jiang, Zhang & Qiu, 2008); some tended to explore annotation reading strategies and teaching cases (Bao, 2007; Hao, 2008; Tang, 2009; Yang, 2006; Yang & Si, 2010).

On the whole, all these studies aforementioned are fully confident of the positive effect of annotation on reading. However, most studies conducted by Chinese scholars are qualitative analyses and experience summarization. Experimental research and quantitative analyses are lacking.

Research of annotation reading outside of China

In the literature, much research work on annotation reading was conducted. Chun and Plass (1996) explored the effects of multimedia annotations on second language vocabulary acquisition with 160 college students using CyberBuch. The findings showed significantly higher scores for words that were annotated with pictures and text than for those with video and text or text only. Wolfe (2000) studied the effect of annotations on student readers and writers. One hundred twenty-three undergraduates participated in this experiment; results indicated that annotations could improve recall of emphasized items, influenced how specific arguments in the source materials were perceived and decreased students' tendencies to unnecessarily summarize. Ariew and Ercetin (2004) explored whether different types of hypermedia annotations facilitated reading comprehension for intermediate and advanced English as a Second Language learners. Surprisingly, it came to a conclusion that annotation use did not facilitate reading comprehension. Hwang, Wang and Sharples (2007) developed a web-based tool for creating and sharing annotations, and investigated the effect on learning of its use with college students. The findings showed that after full annotation sharing, the achievements of the experiment class were significantly higher than those of the control class. Johnson, Archibald and Tenenbaum (2010) measured the effects of four different highlighting and annotation practices on reading comprehension, critical thinking and metacognition in second-semester Freshman English classes in America. They drew the conclusion that students benefited in reading comprehension and metacognition when they completed the tasks of annotation in groups, but no such effect appeared for critical thinking skills. AbuSeileek (2011) investigated the effect of gloss presentation in different text locations, while participants read EFL (English as a Foreign Language) texts in a hypermedia environment. Research data suggested that reading passages with hypermedia annotations significantly benefited passage comprehension and vocabulary (compared to reading passages with no annotations). In addition, some research aimed at figuring out the effect of hypertext annotation presentation formats on perceived cognitive load and learner control (Yao & Gill, 2009); some tried to find out the correlation between annotation and students' writing and speaking performance (Hwang, Shadiev & Huang, 2010); some focused on the effectiveness of hypermedia annotations for foreign language reading (Sakar & Ercetin, 2005).

In summary, these studies showed that annotation has a positive effect on promoting students' reading ability and others. However, students' cognitive engagement degrees are different during reading, so there are different reading levels. These issues, effects of annotation on different reading levels and possibilities of annotation promoting deep processing of reading materials, need to be addressed clearly. Most of the earlier mentioned studies pay little attention to this significant issue. Due to the qualitative analyses nature of past studies in China, and the lack of research on how annotation tools influence Chinese reading levels globally, more research is needed.

Problem statement

As mentioned earlier, surface reading is spreading widely in primary and secondary education in China. Although most studies about annotation reading have been conducted in China and

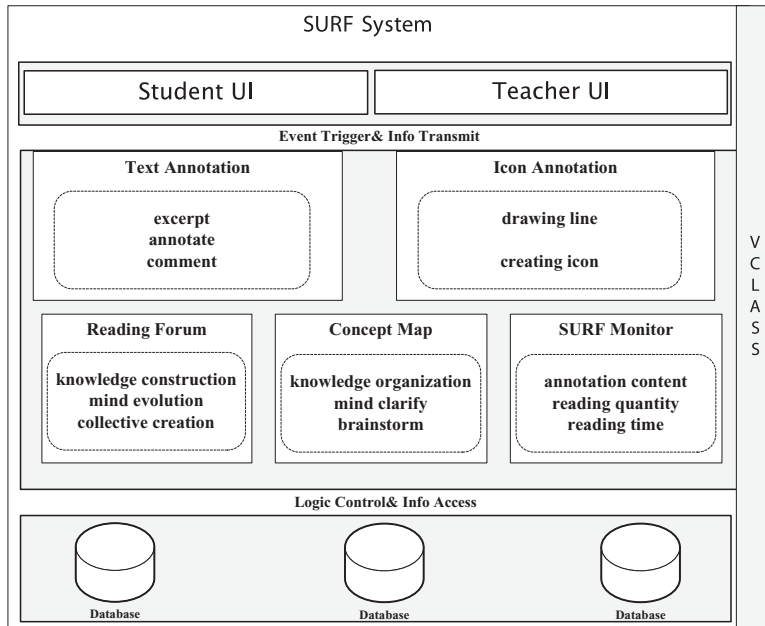


Figure 1: The system architecture of SURF

outside of China, few have focused on Chinese reading levels. Therefore, this study intended to address the issue of surface reading in Chinese class. Specifically, this paper explores the application of a collaborative annotation tool called Sharing Unique Reading Feeling (SURF) in classroom teaching, and investigates the effect of SURF on Chinese reading levels with primary school students.

Overview of SURF

In this study, SURF, as a kind of collaborative annotation tool, was developed to improve classroom reading instruction, and had been broadly used in more than 20 schools in south China. SURF is the key component embedded in an e-Learning platform called VClass specially developed for Chinese elementary and secondary schools. As shown in Figure 1, SURF is designed to provide the following five functions: (1) text annotation; (2) icon annotation; (3) reading forum; (4) concept map; and (5) SURF monitor.

Text annotation

Text annotation consists of three subfunctions: text excerpt, text annotation and text comment. It enables students to make extracts of favorite sentences and words just by selecting them then right-clicking the mouse. All these excerpted contents could be reviewed or edited anytime later, and could also be picked up as materials for writing. Text annotation can help students pay more attention to reflecting on current reading material. When meeting with some excellent sentences or paragraphs, students are able to write down their valuable ideas in time. Once submitted, the background of selected texts will be highlighted. Moreover, students can post their viewpoints of current reading article. All the annotations and comments are open and sharable among the whole class.

Icon annotation

Sakar and Ercetin (2005) revealed that learners preferred visual annotations significantly more than textual and audio annotations. In contrast with text annotation, icon annotation supplies a

better visual effect. There are six types of icon, which are explanatory icon, question icon, impression icon, commentary icon, help icon and imagination icon. Every type has a specific and clear implication, so students can use these icons to make annotations on texts. All the icons on the web page could be dragged anywhere at will.

Reading forum

Knowledge Forum (KF) is an electronic group workspace designed to support the process of knowledge building and to foster thinking and learning skills. Some studies have been conducted to investigate the application effects of KF in primary schools (So, Seah & Toh-Heng, 2010; Zhang, Scardamalia, Reeve & Messina, 2009). Certain results showed that KF had positive impacts on scientific knowledge and could alter the relationship between students and knowledge (Caswell & Bielaczyc, 2002). Certain studies indicated that children were motivated to read others' notes on KF and were benefited in developing literacy (Pelletier, Reeve & Halewood, 2006).

Based on the core idea "extending thoughts & building knowledge community" of KF, a reading forum in SURF has been designed and developed. A reading forum is an open discussing environment, where all the posts are organized by net structure. It demonstrates the road map of students' minds partly. Considering the management and information security, teachers have the authority to set up and remove discussion topics, while students can participate only.

Concept map

With the purpose of assisting students analyzing the organization of article, the complex relationships among different characters or the development clues of event quickly, an online concept mapping tool has been developed. Without any client installation, students can use a concept mapping tool to facilitate reading comprehension with a browser. After finishing concept map drawing, the students can publish their works to share with others.

SURF monitor

Monitoring students in the classroom is as important as providing learning guidance for students. SURF monitor is helpful for teachers to know students' reading progress and annotation well. With the monitor, teachers could see every student's reading time, reading quantity, records of annotation, average reading time of the whole class, the most popular articles, etc.

SURF-based collaborative reading instruction

The traditional model of reading instruction with a teacher-centered structure is unable to meet the teaching and learning needs within the context of e-Learning. Thus, researchers propose to walk towards learner-centered classroom structure to embody students' subjective status (Antónic, 1999; Khan, 1997). In a computer classroom, teachers can use SURF to build an ideal collaborative reading environment. In order to provide guidance for Chinese teachers in primary schools, a practical Collaborative reading instruction (CRI) model as shown in Figure 2 has been designed. The model below demonstrates the basic process of CRI under the support of SURE. Many Chinese teachers in the pilot schools have accepted this model, and some excellent teaching cases have been generated.

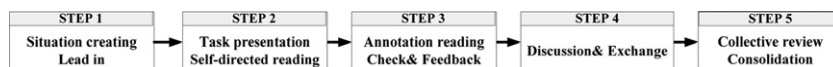


Figure 2: Process of collaborative reading instruction based on SURF

(1) Situation Creating and Lead in

Creation of a situation closely relevant to current reading theme aims to arouse students' interests in the following reading instruction, and to make them prepared for the upcoming learning tasks. There are various methods for leading in (Qian, 2005; Wu, 2007), such as reviewing previous stuff, telling an interesting story, playing a little game, posing questions, etc. Teachers could use these effective strategies synthetically to stir up the learners' enthusiasm and then lead in the next formal reading instruction.

(2) Task Presentation and Self-Directed Reading

In this step, teachers first present some specific reading tasks and reading requirements through PPT slides or dictation, then provide the selected reading materials on the e-Learning platform and allow students to login to VClass platform to conduct self-directed annotation reading by SURF. Teachers could also pick up a core reading material, extract the key contents (ie, comprehension of key paragraphs, style of writing, implied meaning), summarize appropriate reading methods and leave the rights to students to learn other materials with these methods under the support of SURF.

(3) Collaborative Annotation, Check & Feedback

This is a very important step in this model. When students finish the reading tasks assigned before, teachers begin to check the progress of students and give feedbacks adaptively. After checking, the teachers can arrange some time during which students browse the annotations of others, reply or answer classmates' questions, finally get a thorough understanding of current reading contents.

(4) Discussion & Exchange

A reading forum is an important centralized discussion space. Teachers can design a few discussion topics closely related with current teaching goal, and post them in the reading forum. Then students participate in the discussion together to build and exchange ideas collectively. Some excellent and distinct posts could be emphasized and explained further by teachers.

(5) Collective Review & Consolidation

At last, students review what they have read and learned from this class under the guidance of their teacher to consolidate learning contents in this class.

Effects of SURF on primary students' reading level

In the earlier section, the model of CRI based on SURF is presented to enable teachers and researchers to get a quick understanding of the specific application of SURF in class. In order to test the effects of collaborative annotation supported by SURF on primary students' reading levels, two experiments with the same method in elementary classrooms were conducted. In the following part, firstly the definition of reading levels is given, and then the experiments are introduced.

Classification of reading levels

Mo (1993) classified Chinese reading ability from two dimensions, cognitive objectives and teaching contents. With this two-dimensional classification method, the classification of Chinese reading instructional objectives as shown in Table 1 are drawn by combining revised Bloom's taxonomy (Anderson *et al*, 2000) and current Chinese teaching contents. In consideration of the great difficulties in measuring students' creativity in reading, the top cognitive level known as creating is replaced by summarizing frequently used in describing Chinese reading instructional objectives. All the teaching contents are selected from the Full-time Compulsory Education Curriculum Standard of Chinese (FCECSC) and frequently used in instructional design and reading test.

The instructional objectives in this paper refer to objectives in the cognitive domain without the ones in the affective domain. According to revised Bloom's taxonomy, remembering, understand-

Table 1: Classification of Chinese reading instructional objectives

	Remember	Understand	Apply	Analyze	Summarize	Evaluate
Word	*	*	*	*		
Sentence	*	*	*	*		*
Text meaning		*		*	*	
Text theme		*		*		
Text structure		*	*	*		
Writing method		*	*	*		*
Writing style		*		*		*

Note: The first row indicates different cognitions, and the first column indicates different reading teaching contents. The asterisk (*) shows that is one kind of Chinese reading instructional objective.

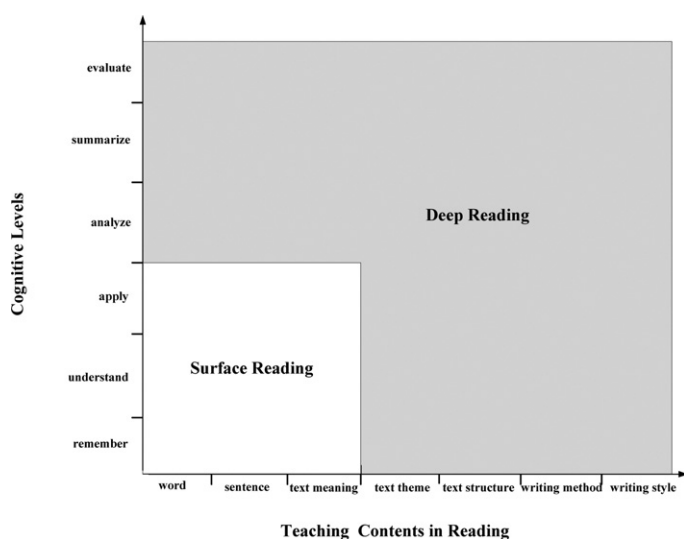


Figure 3: Divisions of Chinese reading levels

ing and applying belong to the lower-level cognitions, while the others are at higher levels. On the basis of revised Bloom's cognitive levels and different required levels of reading teaching contents in the FCECSC, reading levels can be defined as follows (See Figure 3).

On the whole, there are two kinds of reading levels, the surface level and the deep level. Surface reading means less cognitive engagement and less difficulty, mainly including the remembering, understanding and applying of simple and basic teaching contents, like words, sentences and text meanings. On the contrary, deep reading needs students to think more about these high-level contents (eg, text theme, text structure, writing method, and writing style).

Research hypothesis

The following questions will be identified during the experiments:

1. Can the collaborative annotation supported by SURF promote primary students' reading performance?
2. Can the collaborative annotation supported by SURF enhance primary students' reading level effectively?
3. Is it helpful to develop primary students' higher-level cognitive abilities by using SURF in CRI?

Based on these questions, the research hypotheses are determined as follows.

The reading performance of students using SURF is significantly better than that of those who do not use SURF. The collaborative annotation supported by SURF can enhance the reading levels effectively in classroom reading. The collaborative annotation supported by SURF is also helpful to develop primary students' higher-level cognitive abilities.

Experiment design

In order to evaluate the effect of collaborative annotation supported by SURF on Chinese reading levels, methods of equal group experiment, interview and comparative analysis were adopted. In order to validate the experiment results repeatedly, two studies were conducted with the same method and procedure. Study 1 was done in November 2008, in Class 1 and Grade 6 at Xiangnan Primary School; Miss He was the instructor. Study 2 was done in December 2008, in Class 6 and Grade 6 at Qianhai Primary School; Miss Qiu was the instructor.

Participants

The experiments comprised 66 students (Grade 6, Mean age = 11.5 years) and two Chinese teachers from primary schools in Shenzhen, an open city in south China. Thirty-two of the students were in Class 1, Xiangnan Primary School, and the other 34 came from Class 6, Qianhai Primary School. Both of the schools mentioned above were public, and were in medium level of quality of education among all schools in Shenzhen. Both of the experiment teachers were female, and had more than 2 years teaching experience in a computer classroom. All the students who participated in the experiments had been used to learning in computer classrooms, and were experienced in operating computers and using VClass.

Contexts

Experiments were conducted in a computer classroom, where every student had a laptop, and a multimedia teaching system with PC, projector, electronic whiteboard, etc. was equipped. Every computer could access the Internet directly. A VClass software system had been deployed in every experimental school, and SURF was embedded in VClass as a learning tool. Teachers and students could login to VClass platform to use SURF for annotation reading. Two months before the experiments began, participants were trained for 2 hours to ensure that SURF could be used correctly in class. During the experiments, students in the control groups could not use SURF to annotate and share by technical means.

Experimental/control groups design

One week before the experiments were conducted, all public schools in Shenzhen participated in a formal midterm reading test. Therefore, in both studies, the experimental group and the control group were divided mainly according to students' midterm reading test scores. Furthermore, in order to ensure that the two groups were similar, students in every study were ranked in light of test scores and the experiment teacher's mastery of students' reading abilities. Then, all the students who ranked even were assigned to the experiment groups, and all the ones who ranked odd were assigned to the control group.

Instruments

The instruments employed in the experiment included reading test papers and teacher interviews. The recent midterm reading test, held by the Shenzhen Education Bureau, was taken as the pretest for its high reliability and validity. The post-test paper was designed by the experiment teachers and the authors together. The experiment teachers' teaching experiences played an important role in making the test paper. Question types adopted in the test paper had four kinds: single choice question, fill in the blanks, short answer question, and write sentences following the example. All these selected question types were most frequently used in all kinds of Chinese

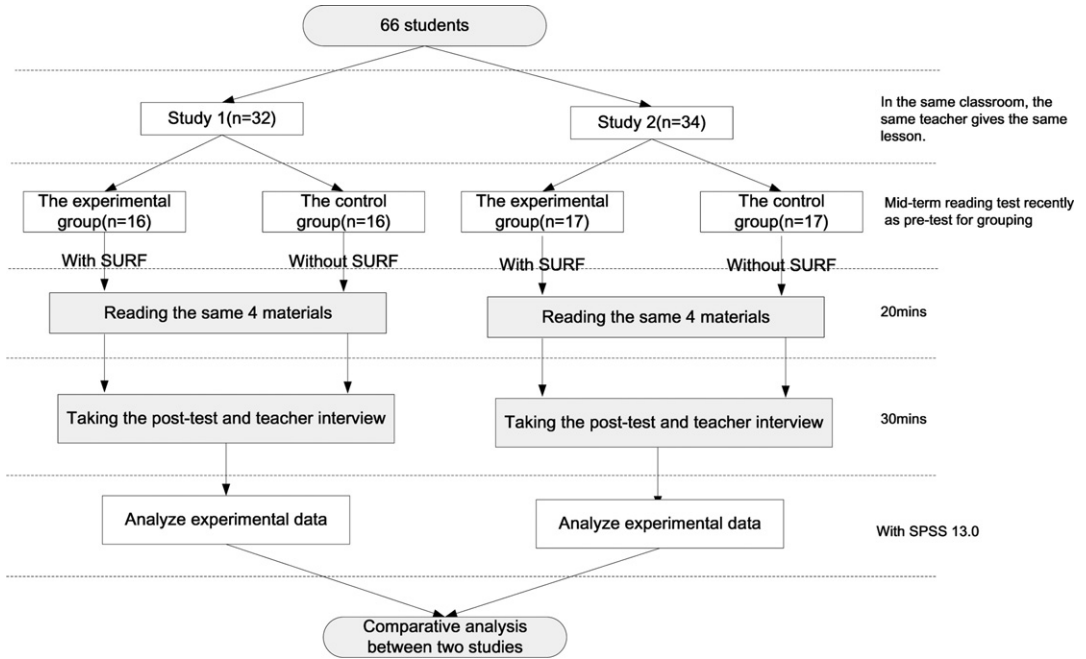


Figure 4: Experimental process

reading tests. After finishing the post-test paper, five nonparticipants in this experiment had a test with this paper to ensure its clearness and availability. Through the analysis of the test results and communications with these nonparticipants, the experiment teachers reexamined the test paper and improved some question expressions, and no test items were needed to be replaced. Besides the test paper, two 45-minute semi-structured interviews with the experiment teachers were conducted to find more detailed information about the effects of SURF on students' reading (for interview questions, see Table 8)

Procedures

Experiments were conducted according to the steps outlined in Figure 4.

After using SURF about 2 months to carry out CRI, the experiment teachers selected one unit from the textbook, designed a topical unit reading instructional plan according to the model of SURF-based CRI, and prepared four materials for reading in class. Then a reading test paper was made by the researchers and the experiment teachers together; all the items of which were consistent with examination requirements in Chinese elementary and secondary schools, and were made according to reading texts above. According to the method of experimental/control group design, students were divided into two similar groups. After grouping, the teacher gave a lesson according to the reading instructional plan designed earlier. During the process of reading, students in the experimental group could make use of SURF for annotating and sharing, while students in the control group could just read with no authority to use SURF. Twenty minutes were guaranteed to have students finish all the four extended reading materials. When class was over, a post-test of reading was carried out immediately, and all the test papers of the students were collected. Meanwhile, interviews with the experiment teachers were conducted. Students' test papers were marked by the experiment teachers. After the marking ended, all the test data were analyzed statistically with SPSS 13.0 (SPSS Inc., Chicago, IL, USA). Finally, comparative analysis between the two studies was made to verify the research hypothesis.

Table 2: Result of independent sample t-test in total scores in study 1

Group	n	Mean	SD	t	p
A	16	58.875	11.0174	2.830**	0.008
B	16	48.188	10.3310		

** $p < 0.01$.

Table 3: Result of independent sample t-test in cognitive levels in study 1

	Group	n	Mean	SD	t	p
Remember	A	16	8.44	3.140	0.991	0.330
	B	16	7.31	3.281		
Understand	A	16	21.500	5.3323	1.757	0.89
	B	16	18.313	4.9223		
Apply	A	16	4.69	1.852	0.690	0.495
	B	16	4.31	1.138		
Analyze	A	16	18.28	4.662	2.627*	0.013
	B	16	13.97	4.664		
Summarize	A	16	2.22	1.472	0.436	0.666
	B	16	2.00	1.366		
Evaluate	A	16	3.75	2.113	2.426*	0.022
	B	16	2.28	1.183		

* $p < 0.05$.

Data analysis and results

Result of study 1

Four reading materials were provided. Both Group A (Experimental Group) and Group B (Control Group) had 16 students. A total of 26 questions that involved all the Chinese reading instructional objectives and reading levels were prepared for the post-test with 100 points as full mark.

(1) Comparative analysis of total scores

As the result shows (see Table 2), the average score of the experimental group (Mean = 58.88) is significantly higher than that of the control group (Mean = 48.19). The standard deviation of the experimental group is a little larger than that of the control group. In addition, there are indeed highly significant differences in post-test total scores between the experimental group and the control group ($t = 2.830$, $p = 0.008$).

(2) Comparative analysis of cognitive levels

As the result shows (see Table 3), the average scores of the experimental group are all higher than those of the control group in six different cognitive levels. And the p values in the analysis and evaluation are 0.013 and 0.022 separately. Both are smaller than 0.05. For this reason, it is confirmed that there are significant differences within the 95% confidence interval in the analysis and evaluation between the experimental group and the control group. But no statistically significant differences exist in other cognitive levels.

(3) Comparative analysis of different reading levels

In Table 4, the average scores of the experimental group in surface reading and deep reading are 24.5 and 34.38, and the contrast ones are 20.94 and 27.25. Thus, it is clear that in both surface reading and deep reading, the scores of the experimental group is much higher than the control group. In standard deviations, there are fewer differences in surface reading and deep reading. Moreover, the result shown in Table 4 indicates that there are highly significant differences between the experimental group and the control group in deep

Table 4: Result of independent sample t-test in reading levels in study 1

	Group	n	Mean	SD	t	p
Surface reading	A	16	24.500	5.6244	1.872	0.071
	B	16	20.938	5.1312		
Deep reading	A	16	34.38	6.982	2.830**	0.008
	B	16	27.25	7.259		

** $p < 0.01$.

Table 5: Result of independent sample t-test in total scores in study 2

Group	n	Mean	SD	t	p
A	17	54.59	11.830	2.494*	0.018
B	17	45.12	10.255		

* $p < 0.05$.

reading ($t = 2.830$, $p = 0.008 < 0.01$). However, although the average score of the experimental group is higher than that of the control group in surface reading, there are no statistically significant differences in fact.

Result of study 2

A total of 34 students participated in study 2. There were 17 students in both Group A (Experimental group) and Group B (Control Group). The experiment process, test paper structure, test item quantity and test question types are almost the same with that in study 1.

(1) Comparative analysis of total scores

As the result shows (see Table 5), the average score of the experimental group is 9.47 higher than that of the control group and the p value is $0.018 < 0.05$. It indicates that significant differences exist in total scores within the 95% confidence interval between the experimental group and the control group, which is consistent with the result of study 1.

(2) Comparative analysis of cognitive levels

As the result shows (see Table 6), the average scores of the experimental group are all higher than those of the control group in every cognitive level. Moreover, the p values are all smaller than 0.05 in analysis ($p = 0.046$), summarization ($p = 0.049$) and evaluation ($p = 0.031$). So within the 95% confidence interval, there are significant differences between the experimental group and the control group in these three cognitive levels. In contrast with the result in study 1, significant difference appears in summarization here.

(3) Comparative analysis of different reading levels

In Table 7, the average scores of the experimental group in surface reading and deep reading are 23.59 and 31.00, and the contrast ones are 21.91 and 23.21. It is clear that the average score of the experimental group is higher than that of the control group both in surface reading and deep reading. In standard deviations, there are fewer differences in surface reading. However, in deep reading, the SD value in the experimental group is 2.6 points higher than that of the control group. This shows that disequilibrium in the experimental group is larger than that in the control group. That means the performance of good students is far better than backward students in the experimental group. Moreover, the result shown in Table 7 indicates that there are highly significant differences between the experimental group and the control group in deep reading ($t = 2.761$, $p = 0.009 < 0.01$). However, in

Table 6: Result of independent sample t-test in cognitive levels in study 2

	Group	n	Mean	SD	t	p
Remember	A	17	9.588	2.6706	1.088	0.285
	B	17	8.559	2.8443		
Understand	A	17	19.353	4.3581	1.591	0.121
	B	17	16.971	4.3713		
Apply	A	17	3.68	0.934	0.549	0.587
	B	17	3.44	1.499		
Analyze	A	17	15.21	5.202	2.081*	0.046
	B	17	11.76	4.409		
Summarize	A	17	5.15	3.230	2.050	0.049
	B	17	3.18	2.298		
Evaluate	A	17	4.15	2.283	2.257*	0.031
	B	17	2.71	1.312		

* $p < 0.05$.

Table 7: Result of independent sample t-test in reading levels in study 2

	Group	n	Mean	SD	t	p
Surface reading	A	17	23.59	4.941	0.935	0.357
	B	17	21.91	5.498		
Deep reading	A	17	31.00	9.462	2.761**	0.009
	B	17	23.21	6.780		

** $p < 0.01$.

Table 8: Interview outline

#	Questions
1	What's different after using SURF in your reading class?
2	Can SURF really promote students' deep reading?
3	Any suggestions for SURF?

surface reading ($t = 0.935$, $p = 0.357 > 0.05$), there are no significant differences within the 95% confidence interval.

Result of interviews

In order to validate the effectiveness of SURF on primary school students' reading levels further, both the experiment teachers were interviewed. The interview outline is shown in Table 8. Comments from the interviews further confirmed the positive effect of collaborative annotation supported by SURF on reading. For example,

- (1) SURF really has a better effect on deep processing of texts. I think its advantages mainly embody in three ways as follows: enhancing the ability of analyzing words and sentences; promoting the deep comprehension of text meanings; improving the capabilities of systematizing and ordering. (By Miss He).
- (2) Students become more concentrated and reflective during reading. They are changing their habits of reading alone slowly, and have more interests in sharing their annotations and ideas. (By Miss Qiu).

- (3) I like the function of Reading Forum very much. It covers the shortage of insufficiency in classroom communication. Our students can read and reply posts at noon, at break time or at home. Moreover, students spent more time in thinking instead of browsing. Good reading habits in e-Learning environment are gradually formed. (By Miss He).
- (4) SURF should be strengthened in categorizing different annotation information. Otherwise, along with the increasing of annotations, it will be more and more chaotic in management. (By Miss Qiu).

Through interviewing with the experiment teachers respectively, it is known that collaborative annotation supported by SURF in Chinese reading class is highly spoke of. Both of the teachers gave a positive answer to the effect of SURF on improving Chinese reading instruction in computer classrooms. Miss He considered SURF as a good assistant in reading instruction, and summarized the advantages of collaborative annotation supported by SURF as well. They were enhancing the ability of analyzing words and sentences, promoting the deep comprehension of text meanings and improving the capabilities of systematizing and ordering. In addition, through checking the data stored in the database, it was found that more than 5000 posts in the Reading Forum had been produced in only 2 months. This explains the special love of reading forum in SURF by Miss He. Meanwhile, it shows that the students in her class often use SURF in reading class.

Besides the approval of the better effect of collaborative annotation supported by SURF on the deep processing of Chinese reading materials, it is surprising to know the improvement in the students' reading habits in Miss Qiu's class. This finding echoes the results of previous studies (eg, Lin, 2011; Qin, 2010). Miss Qiu mentioned that her students became more concentrated and reflective during reading. Miss He also mentioned this point in the interviewing process. At the end of the interview, Miss Qiu gave her valuable suggestions about improving SURF.

Discussion

Both of the experimental results show that with respect to total scores and deep reading, there are significant differences between the experimental groups and the control groups. It is different from the findings of Sakar and Ercetin (2005). They stated that annotations might have hindered reading comprehension. In Sakar and Ercetin's study, participants used a kind of multimedia annotation tool to add more audio, video, texts, pictures on reading texts. According to the theory of multimedia learning, too much information will cause cognitive load, especially in learning unfamiliar knowledge. In addition, they studied foreign language, which needs more positive cognitive engagement than native language learning. Therefore, teachers should pay attention to cognitive load while teaching difficult reading contents. Furthermore, experiments should be conducted to examine cognitive load of SURF compared to other tools. There is another empirical study of using annotation to promote reading comprehension. Chen, Chen and Sun (2010) found a significant improvement in the reading scores of Taiwanese high school students, which is consistent with the findings in this paper. Distinct from their study, the experiments in this paper were conducted in primary schools of mainland China.

In surface reading (eg, word remembering, word understanding, text meaning understanding), scores of the experimental groups are higher than that of the control groups, but there are no significant differences. That is to say that collaborative annotation supported by SURF can improve surface reading to some extent, but will not produce substantial influence. Differences in low-level cognitions (ie, remember, understand, apply) are small. That means that the collaborative annotation supported by SURF has a positive effect on low-level cognitions, but there are no significant differences. As mentioned earlier, SURF aims to solve the problem of surface reading in Chinese reading class by promoting students' deep processing of reading materials. The design of every function in SURF is based on interaction-oriented idea. Collaborative annotation supported

Item No.	Total score	Surface reading	Deep reading	Memorization	Comprehension	Application	Summarization	Analysis	Evaluation
Study 1	.008	.071	.008	.330	.089	.495	.666	.013	.022
Study 2	.018	.357	.009	.285	.121	.587	.049	.046	.031

Figure 5: Comparisons of Sig. (two-tailed) values between study 1 and study 2

by SURF specially focuses on the achievement of deep reading through multiple interactions during reading, like annotating, drawing, discussing, sharing, etc. The effect of multiple interactions on reading is not strengthening the memorization and comprehension of reading materials simply, but is developing high-order capabilities of reading and cognition. Therefore, it is not unusual to find some improvements but no significant differences in surface reading and low-level cognitions.

In addition to the reading performance, there are also significant differences with respect to the effects of collaborative annotation on deep reading and high-level cognitions. Both studies in this paper draw the same conclusions except for the cognitive level of summarization (See Figure 5).

Note that in the 8th column of Figure 5, the p value is 0.666 in study 1 and 0.049 in study 2. The only inconsistency in both studies needs to be analyzed seriously. At the sight of this inconsistency, both of the experiment teachers were contacted. After an in-depth communication, it was found that Miss Qiu always guided her students to use the function of concept map in SURF to assist summarizing text meanings, analyzing structures, and organizing writing ideas during CRI. She said her students liked drawing concept maps very much. However, Miss He said her students had never used the function of concept map in SURF because she thought that it was a little waste of time to draw in class. Through checking the data stored in the database, it was found that there were no signs of using concept map indeed in Miss He's class. After checking the data collected from Miss Qiu's class, two concept maps drawn by the students Wang and Liu about the structure of one reading test material were found. Sharing is one of the key features in SURF, and any concept map drawn by anyone can be listed at the left side of the web page containing the reading text. So the two concept maps could be seen and shared by every student who used SURF during reading. The wisdom of the two students was disseminated among the experimental groups. That is why the experimental group is significantly different from the control group in study 1. This implies that drawing concept maps could improve students' ability of summarizing to some extent. Chang, Sung and Chen (2002) also verified that the concept map approach could enhance text understanding and summarizing abilities.

In addition, in order to validate the popularity of SURF used in CRI in primary schools, a questionnaire with a 4-point scale was designed. The questionnaire encompassed a total of six questions, and had good internal consistency reliability with Cronbach's alpha of 0.94. It was delivered to all the participants in the experiments. The findings showed that more than 91% students regarded SURF as a useful or wonderful tool for annotation reading in computer classrooms (see Figure 6). Thus, it can be seen that SURF has been generally accepted, and the continuous collaborative annotation reading based on SURF will make a long-term impact on primary school students' reading literacy.

In summary, the aforementioned findings showed significant differences in reading performance, deep reading and high-level cognitions of analyzing, summarizing, and evaluating. SURF provides varied annotation ways (eg, text excerpt, text annotation, text comment, icon annotation) and a good web space for discussion collectively. Moreover, all the annotations and discussion posts are open and sharable. Every student can not only construct his or her cognitive structure

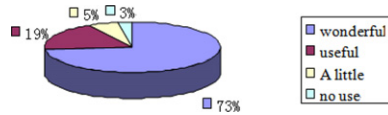


Figure 6: The popularity survey of SURF from students

through annotating, but also see his or her classmates' ideas and opinions freely. Hwang *et al* (2007) also verified the positive effect of creating and sharing annotations on learning with college students. By the way of collaborative annotation reading, students can also develop their higher-order reading and cognitive abilities, which conformed to what was reported by Johnson *et al* (2010), who indicated that students benefited in reading comprehension and metacognition when they completed the tasks of annotation in groups.

Although the hypothesis has been verified successfully, there are still some limitations in this research. Firstly, only 66 students and two teachers were selected as a small sample. In order to generalize, more participants should be considered in future research. Secondly, experiments were conducted in a highly developed southern Chinese city. Considering the North-South differences in China, more experiments should be done in northern Chinese cities. Also, it will be better to conduct such experiment in other countries.

Conclusion and implication

Through thorough cooperation with frontline Chinese teachers, an effective model for CRI based on SURF had been developed to promote CRI in practice. Furthermore, through two experiments, the actual application effects of collaborative annotation in Chinese reading class were verified. The experiment results showed that collaborative annotation supported by SURF could promote students' reading performance and enhance their Chinese reading levels in primary schools. Moreover, it was also helpful to develop higher-level cognitive abilities such as analyzing, summarizing and evaluating. Some similar findings (Chen *et al*, 2010; Hwang *et al*, 2007; Johnson *et al*, 2010) were reported by researchers in recent years, which supported the conclusion of this research. The main contribution of this paper is verifying the real effect of collaborative annotation on Chinese reading levels, which will be helpful for addressing the issue of surface reading in Chinese classes.

Some implications for Chinese reading instruction especially in computer classrooms have also been found. Firstly, collaborative reading assisted by annotation tool should be given profound attention and be applied more generally. Secondly, collaboration is rather significant in developing students' reading literacy, but abuse of collaboration will be a waste of time and will not gain good effects. Thirdly, do not lose the dominant role of teachers, because excessive freedom for students will result in failure in achieving teaching objectives. At last, some competition activities (eg, setting up Reading Stars, giving little and red flowers) should be provided to inspire students to do annotating passionately and seriously.

Additionally, the findings in this research are helpful for policy decisions. The Ministry of Education in China should actively encourage Chinese teachers in primary and secondary schools to implement annotation reading instruction in computer classrooms. Some wonderful annotation tools just like SURF should be developed and generalized in a larger scope supported by the government.

In the future, it is important to conduct such experiments in north China as well as other countries in consideration of areal variations. Meanwhile, to promote CRI model based on SURF, more excellent teaching cases and instructional strategies should be developed.

Acknowledgments

This work was supported by the National Science of Education Tenth “Five-year Plan” Key Project, China, and project number BCA030017. The authors would like to thank Dr. Jingjing Zhang, Dr. Huali Yuan, Dr. Fengguang Jiang, Miss He and Miss Qiu for their help during the study.

References

- AbuSeileek, A. F. (2011). Hypermedia annotation presentation: the effect of location and type on the EFL learners' achievement in reading comprehension and vocabulary acquisition. *Computers & Education*, 57, 1, 1281–1291.
- Anderson, L., Krathwohl, D., Airasian, P., Cruikshank, K., Mayer, R., Pintrich, P. et al (2000). *A taxonomy for learning, teaching, and assessing: a revision of Bloom's taxonomy of educational objectives, Abridged Edition*. Boston: Allyn & Bacon. Retrieved October 15, 2010, from <http://www.amazon.ca/exec/obidos/redirect?tag=citeulike09-20&path=ASIN/080131903X>
- Antónic, M. (1999). The discourse of a learner-centered classroom: sociocultural perspectives on teacher–learner interaction in the second-language classroom. *The Modern Language Journal*, 83, 3, 303–318.
- Ariew, R. & Ercetin, G. (2004). Exploring the potential of hypermedia annotations for second language reading. *Computer Assisted Language Learning*, 17, 2, 237–259.
- Bao, H. N. (2007). Annotation makes reading full of charms. *Reading and Appreciation*, 5, 29–30.
- Best, S. & Marcus, S. (2009). *Surface reading, an introduction*. Retrieved September 10, 2010, from <http://caliber.ucpress.net/doi/abs/10.1525/rep.2009.108.1.1>
- Cai, H. & Tang, X. Y. (2007). A library's deep choice in the era of shallow reading. *Library*, 1, 3, 41–46.
- Caswell, B. & Bielaczyc, K. (2002). Knowledge Forum: altering the relationship between students and scientific knowledge. *Education, Communication & Information*, 1, 281–305.
- Chang, K. E., Sung, Y. T. & Chen, I. D. (2002). The effect of concept mapping to enhance text comprehension and summarization. *The Journal of Experimental Education*, 71, 1, 5–23.
- Chang, Q. W., Chen, X. G. & Zhang, Z. (2009). The theoretical study of social annotation. *Journal of Fuzhou University (Philosophy and Social Sciences)*, 3, 91–95.
- Chen, J. M., Chen, M. C. & Sun, Y. S. (2010). A novel approach for enhancing student reading comprehension and assisting teacher assessment of literacy. *Computers & Education*, 55, 3, 1367–1382.
- Chun, D. M. & Plass, J. L. (1996). Effects of multimedia annotations on vocabulary acquisition. *Modern Language Journal*, 80, 2, 183–198.
- Ding, Y. Y. (2006). Surface reading, the reading revolution in network era. *Journal of Human Mass Media Vocational Technical College*, 6, 4, 65–67.
- Fu, H. (2009). Effective enforcement of Chinese annotative reading in vocational schools. *Vocational Education Research*, 11, 9, 104–105.
- Hao, Z. J. (2008). Primary exploration on the annotation reading in e-Learning environment. *Computer Knowledge and Technology*, 17, 1540–1542.
- Hwang, W. Y., Shadiev, R. & Huang, S. M. (2010). Effect of multimedia annotation system on improving English writing and speaking performance. *Lecture Notes in Computer Science*, 6249, 1–12.
- Hwang, W. Y., Wang, C. Y. & Sharples, M. (2007). A study of multimedia annotation of Web-based materials. *Computers & Education*, 48, 4, 680–699.
- Jiang, H. X. (2009). The educational application of social annotation in e-Learning environment. *Distance Education in China*, 6, 69–74.
- Jiang, H. X., Zhang, J. P. & Qiu, M. (2008). The study of social annotation. *Modern Educational Technology*, 18, 9, 109–112.
- Johnson, T. E., Archibald, T. N. & Tenenbaum, G. (2010). Individual and team annotation effects on students' reading comprehension, critical thinking, and meta-cognitive skills. *Computers in Human Behavior*, 26, 6, 1496–1507.
- Khan, B. H. (1997). *Web-based instruction*. Englewood Cliffs, NJ: Educational Technology Publications, Inc.
- Lin, S. F. (2011). Using effective annotation to pave a road for middle school students' self-learning. *Fujian Tribune (An Economics & Sociology Monthly)*, 1, 59–61.
- Liu, Z. H. (2010). Personal annotation reading in primary school Chinese. *Forum of Education and Teaching*, 33, 79.
- Marshall, C. C. (1997). Annotation: from paper books to the digital library. In Proceedings of *The Second ACM International Conference on Digital Libraries*, 1997 (pp. 131–140). Philadelphia, Pennsylvania, United States.
- Mo, L. (1993). *The research of Chinese school children's reading ability*. Guangdong, China: Guangdong Higher Education Press.

- Pelletier, J., Reeve, R. & Halewood, C. (2006). Young children's knowledge building and literacy development through Knowledge Forum®. *Early Education & Development*, 17, 3, 323–346.
- Qian, S. X. (2005). Discuss the guiding art of teaching in Chinese Class. *Journal of Chengdu College of Education*, 19, 4, 99–101.
- Qin, L. H. (2010). Introducing annotation reading into class and cultivate students' reading habit. *Elementary Education Studies*, 17, 28–29.
- Roberts, J. C. & Roberts, K. A. (2008). Deep reading, cost/benefit, and the construction of meaning: enhancing reading comprehension and deep learning in sociology courses. *Teaching Sociology*, 36, 2, 125–140.
- Sakar, A. & Ercetin, G. (2005). Effectiveness of hypermedia annotations for foreign language reading. *Journal of Computer Assisted Learning*, 21, 1, 28–38.
- Scherer, M. (2009). Challenging the whole child: reflections on best practices in learning, teaching, and leadership. *Alexandria: The Association for Supervision and Curriculum Development (ASTD)*.
- So, H.-J., Seah, L. H. & Toh-Heng, H. L. (2010). Designing collaborative knowledge building environments accessible to all learners: impacts and design challenges. *Computers & Education*, 54, 479–490.
- Tang, S. H. (2009). Using annotation reading method to carry out biographical instruction. *Chinese Monthly*, 5, 40–43.
- Wolfe, J. L. (2000). Effects of annotations on student readers and writers. In *Proceedings of the fifth ACM conference on Digital libraries*, 2000 (pp. 19–26). San Antonio, Texas, United States.
- Wu, Y. P. (2007). Five kinds of classroom lead-in methods. *Literature*, 7, 68.
- Xu, L. Y. (2009). The cause of formation and correction of surface reading's evils. *The Inservice Education and Training of School Teachers*, 10, 35–38.
- Yang, F. (2006). The research of annotation reading instruction (Master dissertation, Northeast Normal University, Changchun, Jilin Province, China).
- Yang, J. F. & Si, Z. Q. (2010). Primary exploration on secondary Chinese annotation reading instruction. *Data of Culture and Education*, 14, 64–65.
- Yang, S. Y. (2008). Develop students' reading personality in annotation reading. *Journal of Fujian Institute of Education*, 11, 11–13.
- Yang, X. M. & Yang, X. F. (2008). Electronic annotation tools used in Chinese reading instruction. *China Information Technology Education*, 11, 73–76.
- Yao, Y. & Gill, M. (2009). The effect of hypertext annotation presentation formats on perceived cognitive load and learner control. *Journal of Interactive Learning Research*, 20, 3, 359–373.
- You, C. Y. (2009). Annotation reading promotes interaction between students and text. *The Communication of Chinese Teaching*, 3, 55–56.
- Zhang, J., Scardamalia, M., Reeve, R. & Messina, R. (2009). Designs for collective cognitive responsibility in knowledge building communities. *Journal of the Learning Sciences*, 18, 1, 7–44.