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The Development and Evaluation of the Science Reading and Essay Writing System

Li-Jen WANG, Yu-An CHEN, Chen-Min LAI, & Ruo-Han CHEN, Ying-Tien WU*
Graduate Institute of Network Learning Technology, National Central University, Taiwan
*ytwu@cl.ncu.edu.tw

Abstract: Popular science reading and science essay writing are parts of the science inquiry activities which can facilitate learners to construct their science knowledge and develop science literacy in school. However, there are a great deal of difficulties and challenges for students to learn how to read popular science articles and write essays. Therefore, helping students read and write should be a crucial issue. Previous research has revealed the effectiveness of teacher community on teachers' professional development. This study developed a "Science Reading and Essay Writing System" (SREWS) as a platform for students to read popular science articles and write essays. After the development of the SREWS, system evaluations were also conducted. A total of 60 senior high school students participated in the system evaluations. The results showed that they expressed satisfactory perceived usefulness and ease of use of the system. Also, they expressed high willingness to use the SREWS. They also appreciated the usefulness and usability of the scaffolding functions of the system. Some suggestions and implications for system design, and future work are also discussed.

Keywords: Science essay writing, science reading, inquiry

1. Introduction

The main difference between popular science and normal science articles is that the former is easier to understand and more accessible for students. However, the main resource of learning science for students is through textbook. When students get older, without textbooks, they tend to lose the opportunity to read popular science articles. As a result, they do not have the skills to summarize the articles they read and then write essays. According to some research, popular science reading and science essay writing are parts of the science inquiry activities which can facilitate learners to construct their science knowledge and develop science literacy in school. Kao (2010) has mentioned that "no scientists can do experiments without knowing anything". That is to say, scientists also need to read relevant articles and write essays to explore scientific phenomenon. However, there are a great deal of difficulties and challenges for students to learn how to read popular science articles and write essays. Therefore, helping students read popular science articles and produce essays should be crucial. Previous research has revealed the effectiveness of teacher community on teachers' professional development. This study developed a "Science Reading and Essay Writing System" (SREWS) as a platform for students to read popular science articles and write essays. The purposes of this study are (1) Develop a platform for helping students read popular science articles and further write essays. (2) Evaluations of SREWS: its usefulness, usability, and willingness of using this platform.

2. System development

2.1 System Framework

The system framework of the SREWS is depicted in the following diagram (See Figure 1). As shown in Figure. 1, this system framework consists of eight main modules and three databases. The three

databases store popular science document data, mission, documents, and users database. The eight modules can be divided into two categories, teachers and students. For teachers, there are four modules which can help teachers upload popular science articles, monitor students, setting up missions, and managing students' data. For students, they can set up essay questions, manage their own essays and popular science articles uploaded by teachers, write their own essays, and finally interact with other students and teachers. Teachers and other students can vote or give comments in the interaction session. With the three databases and eight modules, teachers and students can work together to finish science reading and essay writing tasks.

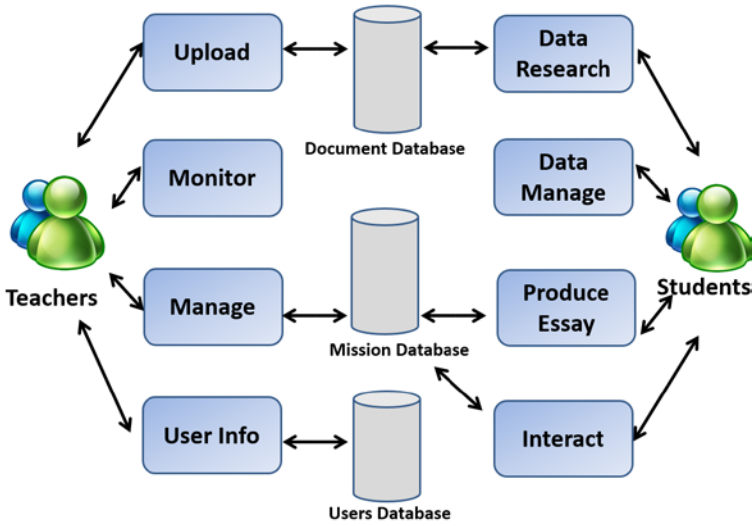

Figure 1. System framework of the SREWS

2.2 System Functions

The functions of the above system modules are further explained in the following table (See Table 1).

Table 1. Functions of the SREWS

Module	Description	Function	User
Upload	Teachers upload popular science articles to the database.	Upload popular science articles	Teacher
Monitor	Teachers can monitor students' status. Teacher can grade students' essays.	1. Monitor students' status. 2. Evaluate students' essays.	Teacher
Manage	Teachers can assign tasks to students	Setting up missions	Teacher
User Info	Teachers can add, edit, and delete students' data.	Manage students' database	Teacher
Produce essay	Students set up essay questions and edit their essays. (See Figure 2)	1. Setting up essay questions 2. Editing essays 3. Essay checklist	Student
Data research	Students can search popular science articles uploaded by teachers and save those articles they need. (See Figure 3)	1. Search articles 2. Save articles	Student
Data manage	Students can write notes or make comments on the saved articles. (See Figure 4)	1. Write notes 2. Make comments	Student

Interact	Students and teachers can grade or give comments on students' essays.	Voting and making comments on essays	Teacher Student

Figure 2: Setting up essay questions and editing page

Figure 3: Searching popular science articles uploaded by teachers and saving function.

Figure 4: Writing notes or making comments on the saved articles.

3. Methodology (System evaluation)

3.1 Participants

There were 60 participants in this study. They were senior high school students who volunteered to join 3 stages camp of popular science writing held by the research team. These students were then randomly divided into control group and experiment group. Their experience of writing science essay were also investigated (See Table 2)

Table 2. Grouping of participants

Experience of writing essay	Experiment Group	Control Group
Never	17	25
Once	12	3
Twice	0	3
Three times	0	1

3.2 Instruments

In this study, the participant students' perceived usefulness and usability of the SREWS as well as their willingness of using the SREWS were evaluated. In addition, the Scaffolding function of SREWS was also investigated. To this end, the 6 Likert-scale questionnaire developed in Phang, et al. (2009) was adapted and used in this study. The first modified instrument consists of three scales: the overall usefulness (4 items), usability (4 items), and willing of use (3 items). The second modified instrument consists of three scales: setting up essay questions (3 items), searching data (3 items), and arranging information (3 items)
The alpha reliability values of the three scales in the first instrument are greater than 0.9, and the overall alpha reliability value of the instrument is 0.95. In the second instrument, the overall alpha reliability value is 0.89.

3.3 Data collection

There were two stages of data collection. First, the authors collected the participant students' essay scores of pretest. Second, after the teaching activities of the camp, the authors collected participant students' essay scores again. Finally, the questionnaires developed and adapted in this study (the usefulness, usability, and willingness of using the SREWS and scaffolding function of the system) were also collected.

4. Major findings and Discussion

4.1 Major findings

The collected data were analysed quantitatively. Table 3 shows that the students' average scores on usefulness, usability, and willingness are between 5.01 to 5.13, which were higher than the 6 Likert scale average score (i.e., 3.5). It indicates that the participants in this study generally held positive attitude toward the system and were willing to use it.

Table 3. The overall results of system evaluation of SREWS

Criteria	Mean	S.D
Usefulness (4 items)	5.13	0.88
Usability (4 items)	5.01	0.85
Willingness (3 items)	5.08	0.81

Table 4 shows that the students' average scores on usefulness of scaffolding functions (setting up

essay questions, searching data, and arranging information) are between 4.68 to 5.17, which were also higher than the 6 Likert scale average score. It indicates that the participants in this study held positive attitude toward the functions of scaffolding provided by the system.

Table 4. The results of system evaluation of SREWS

Usefulness of Scaffolding functions	Mean	S.D
Setting up essay questions(3 items)	4.68	1.01
Searching data (3 items)	5.05	0.78
Arranging information (3 items)	5.17	0.78
Writing Essay (4 items)	4.91	1.02

4.2 Discussion

The aim of this study is to develop a platform which can help students read popular science articles and then write essays expressing their thinking. Most participants expressed satisfactory perceived usefulness and ease of use of the SREWS. Also, they had high willingness to use the SREWS in helping them write science essays. In addition, the scaffolding functions developed in this system also met their demand of science inquiry. In other words, the four scaffolding functions, setting up essay questions, searching data, arranging information, and writing essays, can help students go through the process of science inquiry and further finish science essay writing.

In the analysis of students' scores of essay before and after the learning activities in the three stages camp, we found out that the scores of control group have increased positively. Also, the data collected in this study also shows that the system can help students improve their essay writing skills. In the future system development, more functions of guiding essay writing will be suggested in order to help students produce essays with high quality and quantity.

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