

The effect of utilizing the learning skill of highlighting and constructing a map in a networked hyperlink condition on learning performance

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Abstract—Annotation is a frequently used learning skill. When taking note, the reader only focuses on partial content of a topic or a segment. The note would be non-organized and piecemeal. Therefore, the relationship between topic and annotation would be lost or indirect including the relationship among annotations. Thus, because of the dispersion of annotations, readers would lose the structure of the content that they marked and wrote. In order to integrate the drawback of dispersion of annotation, we designed a system for taking and reorganizing annotation based on the reader's knowledge structure. Therefore, all annotation would be integrated to keep the integrity of it. Thus in this study, we design a system with the function of highlighting and building a map to investigate whether the system enhances the learning performance of reader in a networked structure hyperlink condition.

Keywords-component; ebook; annotation ;highlight; hierarchy structure;

I. INTRODUCTION

Writing down annotation with interpretation next to a word or sentence may catch the theme or main idea of text. In books, the purpose of heading is to point out the theme of a section. The relation between content and title is strong. However, when taking note, the reader only focuses on partial content of a topic or a segment. These notes were non-organized and piecemeal. Therefore, the relationship between topic and annotation would be lost or indirect including the relationship among annotations. Thus, because of the dispersion of annotations, readers would lose the structure of the content that they marked and wrote. When they want to find a note or marked content, they must flip through the pages. This is not an efficient and convenient manner to review.

In order to integrate the drawback (dispersion) of annotation, we designed an ebook system with the function of annotating and building a map through organizing annotation with the reader's knowledge structure to enhance the learning performance of reader in the networked hyperlink condition.

Therefore, all annotation would be integrated to keep the integrity of it.

II. RELATED WORK

A. Annotation

Taking note involves the procedure of input, memory processing, and output.

Previous studies mentioned that annotations are taken in different form. The following are the function of annotation. First, readers use it as procedural signals for pointing out what material needs further attention and what sentences or terms are important. Second, readers use it as contextual cues when searching for wanted content. Using contextual cues to revisit old information is a useful skill [1, 2]. It could also promote learning efficiency during reviewing. Third, it is a way of assisting memory.

In summary, taking and reviewing notes can promote learning efficiency and retention.

B. Concept map

Concept Map was developed by Joseph Novak et al. It is a knowledge representation tool that graphically displays text material in a spatial, node-link network [3]. In concept map, a box that is filled with word or phrase represents a concept. Relations are defined on each arc. When construct it, the learner has to identify main ideas and relate them to each other meaningfully. Thus, relation may help to describe, define, and organize knowledge for a given domain. Constructing a concept map can be considered a meaningful leaning [4, 5, 6]. Previous research shows that it can promote the learning of the central ideas, because they laconically highlight the macrostructure of the knowledge [7, 8].

III. SYSTEM DESCRIPTION

The interface of our system is showed in Fig. 1. With the function of building map, the system separates the screen into two parts. Right side is reading content, while left side is the map. There are two elements in the map. One is "file" (the theme of a section or a sub-theme of a theme), the other one is "note" (annotation content). The file is used to group notes and files. Therefore, the reader can create sub-notes and sub-files in the file. These two elements have two attributes. One is "title", the other one is "content". The readers can highlight the sentences as note and add it into the corresponding file to build their own map. When adding note, the highlighted text will be automatically added as

content, while the first five words will be automatically set as title. The reader must choose the most suitable file to group nodes. For example, if the reader want to add the definition of “job scheduler” and “process scheduler” to map, he/she can highlight the sentence of definition and create a file named “scheduler”, then group them into it. By default, the map only shows title and relation between each file and note. Besides, the reader can choose whether to read the detail or not. The system will show the detail with popup window if the reader moves their pointer to the title of note.

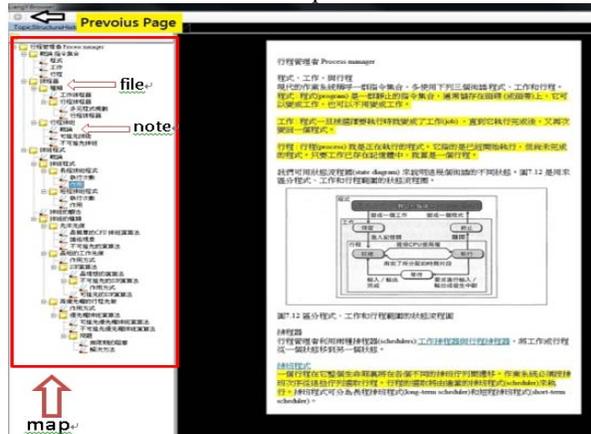


Figure 1. System with functionality of building map.

IV. METHOD

A. Design

This study conducted an experiment to examine the effects of annotation on learning. We designed three reading systems (A1, A2, A3), one reading material, two comprehension test, and a cognitive load questionnaire.

There were totally four dependent variables: textbase micro and textbase macro questions score after reading, textbase micro and textbase macro questions after reviewing.

Thirty three undergraduate students participated into this experiment. Group A1 used the system without aid. Group A2 used the system with the function of annotation (highlighting). Group A3 used the system with the function of building a map that is composed of the collation of annotation. The reading materials are about 10 pages (3900 words). We organized reading content into a networked text structure.

The learning performance was evaluated by two comprehension tests, one for reading and another for reviewing. Each comprehension test consisted of two kinds of questions, namely micro and macro situation model questions. The two kinds of questions were used to evaluate the reading comprehension of the participants on the levels of textbase.

B. Procedure

The experiment was carried out in a usability laboratory. It was divided into three phases: instructing, reading, and reviewing phase.

In the instructing phase, first the whole experimental procedure was explained to the participants. Next, each participant was randomly assigned to one of the experimental conditions and was given 20 minutes to read a text by using the assigned system.

For reading phase, the participants were allowed 30 minutes to read through the assigned reading material by the assigned reading system. Finally all participants had to complete a cognitive load questionnaire and a reading comprehension test immediately.

The reviewing phase was conducted after one week of reading phase. The participants were given 5 minutes to review the material by their assigned system in reading phase. After the 5 minutes, they must complete a comprehension test.

V. RESULT

A. Textbase micro and textbase macro questions score after reading

The mean textbase micro questions scores of using system A1, A2, A3 are 16.18, 17.55, 17.00, respectively. The scores are close to each group. The analysis result from the score of textbase micro questions after reading shows that there is no significant difference among these three groups ($F(2,30)=0.557, p=0.579>0.05$), and the same analysis result as the score of textbase macro is ($F(2, 30) = 0.018, p=0.982>0.05$).

B. Textbase micro and textbase macro questions score after reviewing

The mean textbase micro questions scores after reviewing are that using system A1 is 16.55, using system A2 is 16.63, using system A3 is 17.90. Using system A3 is the best. Using system A2 is in the middle of using system A1 and using system A3. However, the scores are close to each group. The analysis result reveals that no main effect on textbase micro score ($F(2, 30) = 0.55, p = 0.583>0.05$), but the analysis result for score of textbase macro question is ($F(2, 30) = 3.23, p = 0.053>0.05$). Although 0.053 is more than 0.05, but with the wide standard we consider that the difference exists among these three groups. Therefore, we conducted post hoc comparison later. We use the Tukey HSD method to do post hoc comparison. The outcome exhibits that there is a statistical difference between using system A2 and using system A3, while using system A1 gives no difference among using system A2 and using system A3.

C. Cognitive load questionnaire

The average point of each group is as follows: 4.91 for using system A1, 4.82 for using system A2 and 4.73 for using system A3. It is unexpected that using system A3 has the least cognitive load. From the result of analysis, there is no significant different among these three system.

VI. DISCUSSION & CONCLUSION

A. *About textbase micro score after reading*

As we mentioned in the result, the score of textbase micro questions was with no difference. We think the reasons are as follows. First, the reading content is not enough. Second, the reading content was coherent. It was easy to remember. However, the order of mean score is $A2 > A3 > A1$. Subjects with the system assistance (highlighting and map constructing) performed well than those without assistance. As to the reason why mean score of subjects who used system A2 was better than those using system A3, we interviewed some participants. They indicated that map construction distracted their attention from reading content to essay structure. It fitted the result found by Rijk Hofman et al. [9]. Therefore, we think that's why there was no effect on textbase micro score.

B. *About textbase macro score after reading*

About textbase macro score, there is no difference as well. We consider that the same reason with textbase micro score after reading applies. Thus, reading with assistant tool is not necessary. It would increase the cognitive load of the reader. However, according to cognitive load questionnaire, using system A3 had the least cognitive load. It could be explained with the "visual argument" theory that communicating with graphical representation causes less effort than text [10, 11].

Use of the visualization of annotation with map would decrease the cognitive load. However, learning how to use new system would increase the cognitive load of the reader. Therefore, the advantage of our system was reduced. Thus, there was no difference among using these three systems.

C. *About textbase micro score after reviewing*

In review phase, the analysis result of text micro score showed that no main effect on the score of textbase micro questions. We thought the same reason as the one we mentioned in textbase micro score after reading.

D. *About textbase macro score after reviewing*

In the post hoc comparison, the result showed that there was significant difference between using system A2 and A3. Because of with map structure, the reader could view the relationship between each theme. However, unexpectedly, there was no difference between using system A1 and A3. As we mentioned before (reading material is not enough and coherence is high), in addition subjects was not enough. In future work, we will increase the number of subjects to promote our research.

E. *Conclusion*

With the function of ebook, the students could organize their knowledge structure through creating "files" and "notes" to construct the map during reading. When reviewing, the reader could have an overview of hierarchy

structure that is presented by map of whole reading content to enhance the performance of reviewing.

In this way, through browsing the map, the reader can catch the main idea, detail, and structure of text. Furthermore, the reader can understand the relationship of each theme.

In future work, we will increase reading material and increase number of subjects to improve our study.

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