Effectiveness of Highlighting as a Prompt in Text Reading on a Computer Monitor

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Abstract: - In this paper, we examine the influence of highlighting as a prompt to memory on a computer monitor. We conducted an experiment, in which the participants in the experimental group read the text with highlighting provided on a computer monitor, and those in the control group read the text without highlighting, then, they took a test on the content of the text. We found clear evidence that highlighting as a prompt is effective in reading and memorizing the text on a computer monitor. That is to say, prompts are effective in enhancing learning on a computer monitor. Therefore, we recommend to pre-highlight important words, phrases, and sentences in the text of the learning materials when teachers provide them to students on a computer monitor.

Keywords: - Highlighting, prompt, computer monitor, e-Learning, blended-learning

1 Introduction
When we study, we mark important words, phrases, or sentences by underlining or highlighting to help us understand the content. This method is called a “prompt.” The effectiveness of underlining as a prompt on paper has been discussed and proven in earlier studies [1] ~ [5]. In the past decade, multi-media learning materials have been used in various education fields since e-Learning by using web sites and blended learning in a classroom setting have become popular. And that method of studying would be expected to be more common because of its effectiveness. However, the effectiveness of underlining or highlighting in texts of learning materials on a computer monitor has not been revealed yet. Underlining or highlighting by learners on a
computer monitor is still very rare because e-Learning software doesn’t have such a function. Expecting the development of new software in the future, we need to examine the effectiveness of a prompt provided in texts of learning materials on a computer monitor.

The purpose of this study is to prove whether a prompt is truly effective when learners study with a written text on a computer monitor.

2 Literature review

There are many studies on the effectiveness of underlining with on-paper studying. Seki explained that emphasizing key words with a prompt helps learners to understand the content of the text [4]. According to Glynn, underlining as a coding is a stage where learners search for important information [6]. Di Vesta et al. reported that underlining as a study strategy can be considered as a function of coding and memorization that learners use to promote cognitive processes to understand what was taught [7]. Marshall did a research on real textbooks that college students had used, and pointed out 1) underlining is a method of recording, 2) highlight markers and boxes are methods of marking, 3) asterisks, star marks, and arrows are methods of signs, and 4) notes are used as other ways of organizing information. She reported that notes especially were used for understanding the meaning of sentences and for answers to questions, and that markings were often used for recording important concepts of the learned material. Underlining has its effectiveness only when learners review the text that they underlined [8]. According to Johnson et al., underlining as a prompt is efficient when it is used under important words. On the other hand, when it is used under unimportant words, it prevents learners from understanding the content. In order to make underlining effective, learners have to pay attention to important concepts in the textbook and choose them by themselves [9]. That is to say, it is the very activity of underlining forces learners to judge what is important and what is not which has a stronger effect on their understanding of the content than when a prompt is provided in advance (Uozaki et al.) [3].

3 Hypothesis

Learners’ comprehension in reading texts on a computer monitor is higher when important words, phrases, and sentences are pre-highlighted than when they are not highlighted.

4 Experiment

4.1 Participants

A total of 20 college students in a University in Japan participated in this study. They are all science majors including both male and female. We divided them into two groups, experimental group and control group, and conducted the experiment under the following conditions.

4.2 Conditions

The experiment was held in a computer classroom. Each participant sat in front of a computer and adjusted the height of the chair. The computer monitors are 17 inch LCD (1280x1024 pixels, flat, non-glare).

4.3 Study materials and Test

We prepared two study materials on our web site, one for the experimental group and the other for the control group. In the text in the study material for the experimental group, important words and phrases have been emphasized with highlighting by red (ff0000) and pink (ff00ff) respectively (Figure 1).

![Figure 1. Study Material with Highlighting](image-url)
traditional Japanese tea-ceremony room extracted from the web site of “Bikorodo,” a crafts shop of folding screens and scroll pictures [10]. We chose this text about alcove, which is unfamiliar to ordinary people, so that the participants would not be influenced by any prior knowledge or cannot easily guess the answer. We also prepared one test, which has two sets of questions, Section 1 and Section 2. Section 1 has seven multiple-choice questions and Section 2 has eight fill-in-the-blank questions (Figure 2 and 3).

4.4 Procedures
We first explained the experiment to the participants. Then, we randomly divided them into two groups, the control group and the experimental group. We did a fine adjustment of the number of participants so that there would be the same number in each group. Next, we distributed a handout of the procedure. The participants read it and confirmed how and what they should do in the experiment. After that, they opened the index page of our web site in where the test materials were placed, then, they clicked an assigned button for each group to start studying the material all together. They worked for five minutes following our time keeping. After this study period, we distributed the test to both groups, then, both groups took the test for five minutes. When the experiment finished, all of the participants wrote their comments on the study materials. We asked the control group to take a look at the study material with highlighting before they wrote comments, so that they could compare the two versions.

5. Results and Discussion
We analyzed the test scores that the participants marked correct answers. Section 1 of the test has seven questions and Section 2 has eight questions. The averages of the test scores in Section 1 for the experimental group and the control group are 5.4 and 3.8 out of 7 points respectively (Table 1).

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<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
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<tbody>
<tr>
<td>Experimental</td>
<td>5.40</td>
<td>2.01</td>
<td>10</td>
</tr>
<tr>
<td>Control</td>
<td>3.80</td>
<td>1.75</td>
<td>10</td>
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† p > 0.1, t = -1.90

The experimental group marked a better score than the control group. A two-sample t-test showed a difference in the scores in Section 1, which is to say that the experimental group performed better recollection than the control group when they read different type of texts, with prompts and without prompts, on a computer monitor, and answered multiple-choice questions, (t = -1.9; DF = 18).

The averages of the test scores in Section 2 for the experimental group and the control group are 3.1 and 2.5 out of 8 points respectively (Table 2). A two-sample t-test didn’t show a significant difference in the scores in Section 2, which is to say that there was no difference in recollection between the two groups when they answer fill-in-the-blank questions. (t = -.1.02; DF = 18).

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</tr>
<tr>
<td>Control</td>
<td>2.50</td>
<td>1.27</td>
<td>10</td>
</tr>
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We also analyzed this result by observing the distributions of correct answers in Section 2 (Figure 3). According to the graph in Figure 3, both groups marked the correct answer in question #1 and #2. In the experimental group, 9 out of 10 participants marked the correct answer in #1, and 7 out of 10 participants marked the correct answer in #2. In the control group, the same numbers of participants marked the correct answers in both #1 and #2 as the experimental group marked. The word for #1 was a
Figure 3. Distributions of Correct Answers in Section 2

familiar one to ordinal adult, i.e. participants. We can assume that this fact brought the high correct answer ratio. Whereas, other words, #2 - #8, were very new to the participants, therefore, we suspect that the participants only could retain memory for #1, because it was very difficult for them to memorize new words and recall them in a limited time for both of groups.

6. Conclusion and Suggestions for Further Research

We conducted an experiment to know whether highlighting as a prompt is effective when learners read a text of learning materials on a computer monitor. The results of this study show that highlighting is effective in reading texts and answering multiple-choice questions. However, we didn’t find effectiveness of highlighting when participants answer fill-in-the-blank questions because the vocabulary in the text was too difficult for the participants to memorize and recall. That implies that we can expect the effectiveness of highlighting when we choose an appropriate test material for future.

In this study, we pre-provided prompts in the text of the test material. We would like to suggest that future researchers should include an experiment that participants apply prompts by themselves on a computer monitor although Learning software haven’t had sophisticated functions of prompts such as highlighting yet. Expecting the development of new software in the future, we also need to examine what sort of functions should be developed when the study method shifts from paper to computer. If we can prove the effectiveness of prompts on a computer monitor in the future, e-Learning will become a very powerful learning tool.

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