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Strategic Use of Knowledge Media for Conceptual Understanding through Self-Explaining

Jun Oshima, Katsutoshi Yuasa, & Ritsuko Oshima
Shizuoka Univ. Faculty of Education 836 Oya Shizuoka, Japan 422-8529
Tel. 011-81-54-238-4683
joshima@oshima-7.ed.shizuoka.ac.jp

Abstract: The effects of knowledge media for self-explaining in learning were explored. University students listened to a psychology lecture tape in three different conditions of self-explaining. Analyses showed that subjects who used a diagram application to represent their units of ideas in a strategic self-explaining condition manifested superior understanding of learned contents.

Keywords: reflection, scaffolding, visualization

Problems and Purposes

This paper reports a study on the effect of knowledge media on self-explaining. Although self-explaining is an effective learning tool for facilitating conceptual understanding (Chi, de Leeuw, Chiu, & Lavancher, 1994), it obviously increases cognitive load for learners in engaging in learning, i.e., reading, writing, listening, etc. This problem may interfere with understanding because of overload of learned information (Sweller, 1994). We think that new media supported by information technologies (ITs) would decrease such cognitive load by distributing the load between learners and the tools. Our previous study (Oshima, Yuasa, & Oshima, 1998) tested the effects of ITs on self-explaining by comparing two different conditions of learning. We asked undergraduate students to learn on human memory in psychology by listening to a lecture tape, then self-explain their thoughts. In one condition (Normal), learners were asked to self-explain in a normal way. In the other condition (Diagram), learners were instructed to use an electronic diagram application to organize their thoughts. Results showed that the diagram learners could recall more accurate understanding of human memory than the normal learners in post-tests, and that the diagram learners were engaged in more dynamic knowledge integration during self-explaining.

The study reported here was aimed at further exploring the knowledge media effect through improvement of instruction for self-explaining and diagram use. First, for further facilitating learners' conceptual understanding, instruction for self-explaining was revised. Unlike providing learners with general prompts, we invested instruction for more strategic self-explaining (Renkl, 1994). Second, we encouraged learners to use diagrams to articulate their thoughts and questions from the perspective of how the thoughts and questions were related to the human memory model. Learners were given a background view representing the memory model, then instructed to report their thoughts and questions by creating their diagrams around the model view. This study was conducted as an extension from our previous study by setting a new condition in which learners are engaged in self-explaining in a more strategic way, and comparing learners' performance and activities with those in two conditions in our previous study.

Method

Eight undergraduate students at a public university in Japan participated in this study for twenty dollars each. In our previous study, four undergraduate students in each of the two conditions had participated.

Experimental Design and Procedure

In the newly added condition called "strategic diagram," subjects were asked to listen to an audiotape of a psychology lecture, then engage in self-explaining activities after listening to the tape. They were given a handout for the lecture, papers and pencils so that they could take notes. During self-explaining, learners were instructed to use an electronic diagram application to report their thoughts. Unlike Diagram condition in our previous study, learners were not given any categorized boxes to represent their thoughts. We changed our instruction for self-explaining. Instead of asking learners to describe their thoughts along with general prompts, we asked them to describe their thoughts in their own ways. In particular, however, we encouraged them explain their experiences by their learned mechanism, and put meanings in links.

Subjects individually participated in the experiment. They were first asked to explain how they thought human memory functions and their questions on the mechanism, then type in the electronic diagram with human memory model as a background view. Next, subjects were instructed to listen to three sessions of a psychology lecture given a handout of the content summary. They were also told that they could take notes if necessary. The lecture consisted of three sessions, each of which described three different components of the human memory. After listening to each session, subjects were asked to self-explain how the new information could be used to explain their experiences. During self-explaining, subjects were instructed to express their thoughts by typing in the electronic diagram. Their protocols during self-explaining were audio-recorded, and their representations in the electronic diagrams were recorded after each session. After the learning sessions, subjects were presented three tasks for the evaluation of their conceptual comprehension. First, they were explained a procedure of the free-recall experiment and asked to predict its result, i.e., drawing a line of the recall rate (i.e., prediction). Then, they were further asked to explain psychological mechanisms on their predicted results (i.e., explanation). Finally, they were shown the correct result then asked to explain again the mechanism on the correct one (i.e., interpretation). Their protocols during engaging in the tasks were audio-recorded.

Results and Discussion

Two independent experts evaluated subjects' post-test performance by dividing it into three different sections, each of which was explained by a different mechanism. The experts scored subjects' performance with 7-point scales. Since correlations between the experts' scoring were significantly high ($p < .05$), we calculated average scores. 3 (Condition) X 3 (Section) ANOVAs on the scores showed: (1) that subjects in conditions in which the diagram application was used outperformed subjects in Normal condition. Furthermore, we found a significant difference in the interpretation scores that Strategic Diagram subjects outperformed Diagram subjects. Thus, results suggest the effect of the knowledge medium on comprehension through self-explaining.

Based on subjects' protocols during self-explaining, three types of inferences were identified: (1) consideration of coherence of different components of the model, (2) application of the model to their experiences, and (3) transfer of explanations in text to their experiences. 3 (Condition) X 3(Inference) ANOVA showed that Strategic Diagram subjects more frequently engaged in making inferences for applying the model to their experiences. The results suggest that our instructional intervention appropriately worked during self-explaining.

In the two conditions in which diagrams were created, their structures were compared. 2 (Condition) X 2 (Note: single or connected) ANOVA showed that Strategic Diagram subjects produced more units of idea.

In summary, it was found that strategic approach to self-explaining was effective for learners to more engage in inferences, and that the diagram application could support learners to structure their units of ideas for inferences.

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