The effects of concept mapping with computerized tool

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Abstract: In this study I examined and identified conditions for developing conceptual understanding in the support provided by a computerized concept mapping tool. I compared the computerized concept mapping tool and an equivalent paper-based tool, and experimentally found out that the computer mediated tool was more effective in helping students acquire knowledge usable to solve a transfer problem. In order to examine I analyzed the diagrams created by the participants on both tools. The diagrams created on the computerized tool often explicitly connected among them with lines, to explicate the relations among the units. This implies that the features specific to the computerized media, like the ease of unitization and the flexibility of relation-making appear to be responsible for its effect as support for conceptual understanding.

Keywords: diagramming, concept map, technology support, externalization

Problem

This study examined the nature of differences between diagramming with a computer tool and that with the paper. It has been shown that the activity that externalized and mapping concepts or ideas have positive effects on learning (Novak, 1998). Recently they are widely used as a support system for educational practices (Nmiyake, Shirouzu, 2003). In this paper I compared an electric card mapping tool against paper card mapping and show the former is more effective than the later. And I also examine the effects of features specific to the computerized media, like the ease of unitization and the flexibility of relation-making .

Experimental design

There are two conditions in this study. One is the electronic condition and the other is the paper medium condition. Participants in this study were Seventeen undergraduate students with basic computer skills who have not learned psychology yet. Eight was assigned to the electronic medium condition and nine was assigned to the paper medium condition. In the electronic medium condition, subjects were instructed to use the electronic diagram function in commercial software(InspirationTM, see figure 1).on the other hand the paper medium condition participants performed same activity by writing information on sticky notes and putting them on a large paper , they could also relate them together by drawing lines with pencil(see figure 2). Learning topic was the two storage model of human memory (Lindsay, Norman, 1977).

Experimental procedure

Participants individually tested in the experiment. They were first interviewed on their knowledge about human memory. Then they listened to tape recorded lecture on the learning topic with a handout. There were three sessions in the lecture. After listening to each session, they were asked to make diagrams using different medium according to their conditions. At the end of lecture they were tested on the comprehension about the lecture.
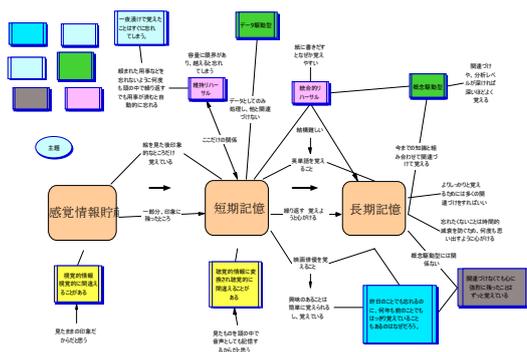
Figure 1: *example of the electronic medium condition*

Figure 2: *example of the paper medium condition*

Comprehension test

The comprehension test asks the participants to apply what they learned from the lecture to understand a free-recall experiment of non-related words (Lindsay, Norman, 1977), which was not explained in the lecture. There were three components in the test. First test 1 asked the participants to predict the results of the free recall experiment. Test 2 asked the participants to explain their prediction using what they learned form the lecture. In test 3 the participants were given the real result and asked to explain the pattern. There were three sub components to each test. Scores for each sub components was evaluated by three independent experts in terms of the conceptual understanding of the contents on seven point scales. By combining those, the combination score for each test is ranged form o to 21. Figure 3 shows the post test results. A2 (condition)*3(test) ANOVA showed that the participants in the electronic medium condition scored higher than those of the paper medium condition in all the tests (F $(1, 30) = 34.05$, $p<.01$). And test 2 is more difficult than other tests (F $(1, 30) = 4.21$, $p<.05$).these analyses show that the participants in the electronic medium condition gained the better conceptual understanding than the counter parts of the paper medium condition.
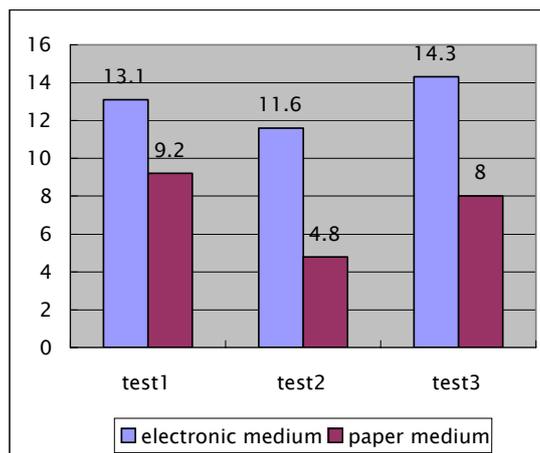
Figure 3: *comprehension test results*

Analyzing diagrams

Diagrams were first analyzed in terms of how the participants externalized the contents of the lecture. The contents of the lecture were divided into 14 idea units. Each diagram was scored by the number and kinds of idea unit the diagram indicated. As a result shown in figure 4 there were not much difference in the number of the idea units or the kind of the ideas externalized. But in the paper medium condition there was a slight tendency that ideas were duplicated.
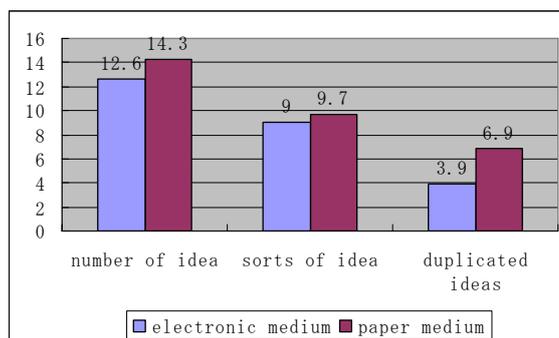

Figure 4: *sorts and numbers of idea*

Analysis of how the ideas were related in the diagrams

Next I examined how the ideas were related in the diagrams. There were three methods the participants used to relate the ideas. One is to draw lines between boxes. Another method is by making two text boxes touch to each other. And the other is to write down several ideas in one text box. I counted the ideas related by each of these methods and compared numbers between the conditions. Also I checked the size of the chunks made by these relating methods. On the types of relating I run ANOVA.

I found significant interaction between two factors（$F（2,45）=3.05, p<.10$）. As shown in Figure 5, the

participants in the electronic medium condition made more line's relations than other types（$F（2,45）$

$=263.8, p<.001$）. And relating by direct touching type was less in the electronic medium condition than

the paper medium condition（F（1,45）=4.26,p<.05）. But as a result shown in figure 6 there was not much difference in number of idea in chunks between the conditions.
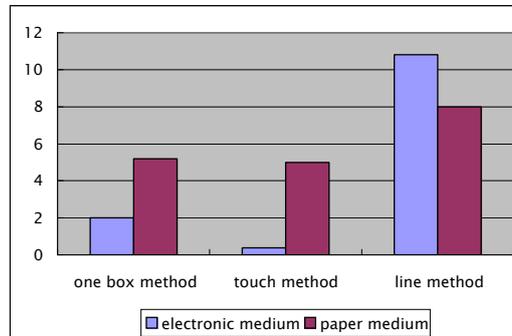

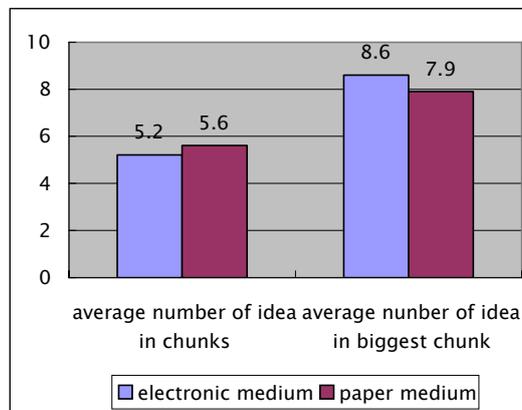Figure 5: *methods of relation*

Figure 6: *number of idea in chunks*

Analyzing duplicated ideas

I further examined the relations made among duplicated ideas and so the difference between the conditions. The focus was on whether those duplicated ideas were related other ideas and also how the duplicated ideas were chunk together. Because individual differences contributed to dispersion there was no statistical significant found, but as figure 7 Indicate regardless of the conditions two thirds of the ideas were related to different ideas. And more than half of the duplicated ideas were included in one chunk
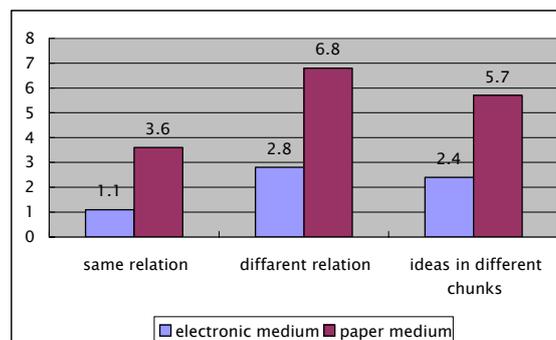

Figure 7: *relations of duplicated ideas*

Discussion

According to the results of the analysis of relating and chunking of externalized ideas in both conditions the participants externalized enough ideas and also made relations and chunks indicating general understanding of the lecture. There were differences between the conditions in terms of how they related their ideas. In electronic medium condition most of the relation making were done through drawing lines and linking the ideas together. Though in the paper medium condition the participants used other methods by relating namely touching the cards together and writing several ideas in the same box more freely than the other condition. I could infer from this difference that in the electronic medium condition the participants could make relations more visible on to the diagrams they were making. And this visibility could have rise their understanding on the comprehension score. In paper medium condition on the contrary there were more duplicated ideas than the other condition externalized on the diagram. And many of duplicated ideas were different places or related to a different idea from each other. This indicates that the participants in the paper medium condition compared to the electronic medium condition had treated smaller idea connections isolated from each other. Because the participants in the electronic medium condition showed better comprehension, using the electronic medium allowed the participants to make better visible the relations among the ideas by links and made more integrated diagrams with less duplicated ideas and this could have helped them to gain better understanding.

From this study

Using electronic medium when diagramming supports highly visible relation making through links which leads into the more integrated diagramming. These features of electronic medium should be taken into account when we design e-learning environment.

References

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