

## **LEARNERS' PERCEPTIONS AND USE OF DIFFERENTLY DESIGNED SCHEMATIC CONCEPT MAPS ON THE FORMATION OF MENTAL REPRESENTATIONS FOR DIFFERENT LEARNING TASKS**

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**Abstract.** Research on the effectiveness of concept maps on learning has long been neglecting three critical issues; i.e., the schematically structured maps, learners' perceptions of the maps, and the various ways of presenting concept structures. When concepts are associated by logical or causal rather than by subsumption relations, variations in selecting concepts and describing their relations may present different perspectives of interpreting knowledge, which may be suitable for different cognitive tasks. This study investigated how three map provision conditions—comprehensive maps, thematic maps, and no maps—influenced learners' formations of mental representations for two history articles, and how these representations related to coherent comprehension and syntheses of key arguments in the articles. The findings showed that people are active evaluators for the usefulness of the provided concept maps. Because different designs of concept map work better with different cognitive tasks, teachers are advised to progressively present the concept structures from the core themes to details.

### **1 Introduction**

Concept maps have been argued to be able to exploit learners' visual memory, to reduce the syntactic complexity and redundancy of textual information, to economize the storage and retrieval of information, and to improve reading comprehension or relational knowledge, especially for the less skilled learners. On the other hand, research on graphic organizers also pointed out the possible limitative effects that providing adjunct displays may cause to learning. Many studies argued that graphically illustrating the organization of content may frame or shallow the way learners process the learning materials, to orient learners to focus more on the terms rather than on the relations or the general message of the text (Moore & Readence, 1984), and to make learners less cognitively engaged during their interactions with the text (Robinson & Kiewra, 1995). These inconsistent findings call for further investigations on the impact of adjunct concept maps on learning. In particular, three critical issues regarding the effectiveness of concept maps have been substantially understudied in the literature; i.e., the schematically structured maps, learners' perceptions of the maps, and the various ways of presenting concept structures.

According to Sternberg (2003) there are two prototypes of concept organizations; i.e., categories and schemas. Currently, the literature of concept maps primarily focused on the hierarchical maps (that feature the concepts as categories prototype). Concepts featuring schematic structures are often more pertinent to the essence of learning social sciences such as history. Instead of reciting the facts of historical events, history educators argued that students need to master the ideas that shape the disciplines of history research; i.e., the "second-order concepts", such as evidence, empathy, duration, causation, and change (Lee & Shemilt, 2003). These second-order concepts would be better represented by schematically structured concept maps.

Literature on reading comprehension shows that the memory of a text involves at least three levels of mental representations (Oakhill, Garnham, & Vonk, 1989): (a) the memory of the imagery or surface features of the way certain words, sentences, or structures are presented; (b) the local level representation that conveys the rudimentary or literal meanings of the semantic molecules that compose the discourse; and (c) the situation model or global level representation that reifies the way the learners interpret the meanings or the implications of a discourse. Concept maps, designed to graphically manifest the knowledge organization, are believed to be helpful for forming the global framework (Hall, Dansereau, & Skaggs, 1992). However, given the constructivist nature undergirding the theory of concept mapping that dismisses the notion of the best way of creating a concept map (Novak & Gowin, 1984), concept maps are rarely at its most representative form that corresponds seamlessly to the text especially when knowledge content is huge and complex. Therefore, in terms of study aids or advance organizer, the question is how different designs of concept maps would influence learners' abilities to handle different learning tasks and how to convey the instructional objectives through the design of adjunct concept maps. Via an experiment conducted in a high school in Taiwan with 88 participants, this study investigated the impact of three map-provision conditions (comprehensive map, thematic map, and no map) on (a) the constitution, (b) the coherence, (c) the interaction between the constitution and the coherence, of mental representations that high school students formed for two schematically structured passages about the most influential historical event in Taiwan history.

## 2 Methodology

An experiment was conducted in a computer lab of a high school in Taiwan. The participants were 88 10th grade students, who participated in this study as a part of a “creative learning project.” All of them had been introduced to the notion and the presentation of concept maps before this study, so they were ready for the experiment.

### 2.1 Experiment Instruments and Procedure

The experiment required the participants to complete the following tasks, and the reading materials were two news articles about the most serious uprising incident —“the 228 incident”— in Taiwan history. (a) Write down what they knew about the 228 incident. (b) Read the first text. (c) Answer 6 reflection questions. (d) Write down what they remembered about the first text, and how they referred to the provided concept map during their recalls. (e) Read the second text. (f) Answer the same 6 reflection questions from the step 3 about the second text. (g) Answer 2 local coherence questions and 4 global coherence questions. (h) Synthesize the two texts and write an essay about the causes of the 228 incident on the basis of the two texts, and how they referred to the provided concept map when they synthesized the contents. The participants were randomly assigned to one of three experimental conditions, i.e., comprehensive map group, thematic map group, and the no map group.

### 2.2 Data Analyses

Participants’ recalls of the first article were first broke down into lists of propositions. Then according to how each proposition represented its associated texts, all propositions were categorized into five types of representations. I.e., (a) duplicative representations, (b) analogical representations (c) problematic representations, and (d) deficit representations. In addition, the influence of the concept maps on the memorization of the texts could be observed from whether the generated propositions were supported by the concept maps or not. Therefore, the propositions generated to represent the news articles could be categorized into three types; i.e., those represented by both the comprehensive map and the thematic map, those represented by only the comprehensive map but not the thematic map, and those represented by no concept map. After the participants’ generated propositions were counted and categorized, along with their scores on the global and local coherent questions, the ANOVA and MANOVA statistical procedures were conducted to analyze how different formations of concept maps influenced the way the participants generated propositions and constructed their mental representations for the texts.

### 2.3 Findings

The multivariate analyses show that the three groups of participants did generate a significantly different amount of propositions across the four types, Wilks’  $\lambda=0.50$ ,  $F(2, 85)=8.51$ ,  $p<.001$ ,  $\eta^2=0.29$ . The follow-up analyses of variance show that the provision of different concept maps did lead to different propositional representations of the text. Between the three map groups, no significant difference was found regarding the number of valid propositions that represent the part of the text covered by both the comprehensive and the thematic concept maps,  $F(2, 85)=0.40$ , ns. The participants from the thematic map group generated the fewest valid propositions representing the text covered only by the comprehensive but not the thematic map,  $F(2, 85)=10.67$ ,  $p<.001$ . In addition, for the six gist questions, the MANOVA analysis shows that there were significant differences in the results among the three groups, Wilks’  $\lambda=0.62$ ,  $F(2, 85)=3.56$ ,  $p<.001$ ,  $\eta^2=0.21$ , and the two map groups generally performed better than the no map group. Moreover, for the four global gist questions, comparison of the mean scores reveals that the no map group performed consistently poorer than the other two groups. Finally, analysis of the synthesized conclusions that the participants made from the two texts reveals significant differences in the number of valid,  $F(2, 85)=6.37$ ,  $p<.01$ , and invalid propositions,  $F(2, 85)=7.68$ ,  $p<.001$  between the three groups. *Post hoc* analyses show that the differences were enhanced by the significant differences between the thematic map group and the no map group for the valid propositions, and between the thematic map group and the other two groups for the invalid propositions.

## 3 Conclusions

Previous research argued that concept maps may direct learners’ attention to individual terms rather than the grand messages (Moore & Readence, 1984), whereas this study showed that it is a matter of how the concept map is designed and how learners perceive the usefulness and purpose of it. Different designs of concept maps work differently with different types of learning tasks. That is, when the map is perceived as well corresponded

with the text and suitable for the cognitive task at hand, it would be easier for learners to treat it as the proxy of the text for the task and serve as the “second stratum cue” (Robinson & Molina, 2002) that back up the textual representation. But when the correspondence is not intuitive or it does not directly connect with the task, learners would actively evaluate the effectiveness of the concept maps and decide how to use them in their learning, rather than passively influenced by the maps. Therefore, to meet learners’ learning capacity and needs, it is advisable to present an interactive concept map starting from the most parsimonious and straight-to-the-points format, and gradually evolve on the details. Progressively demonstrating the concept maps from the core to details can help learners to develop their knowledge of the content with, rather than upon, the presentation of concept maps. So far, not many computer-based concept mapping programs feature such flexibility and interactivity of demonstrating various scopes of a concept map, and this would be an important function to be considered.

#### 4 References

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