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The Influence of Annotation in Graphical Organizers

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Abstract. The effect of annotation in graphical organizers of hypertext learning environments was examined on learning outcomes of low and high prior-knowledge learners for knowledge acquisition and comprehension. Two hierarchical and two network organizers – with or without annotation - were compared. The annotation described the nature of the conceptual relationships depicted in the organizers. No differences were found for acquiring factual knowledge. For comprehension, the annotated hierarchical organizer negatively impacted low prior-knowledge learners as compared to a non-annotated hierarchical one. When the two groups were compared, high prior-knowledge learners scored significantly higher than low prior-knowledge learners with an annotated hierarchical organizer. In the non-annotated network condition, high prior-knowledge learners scored higher than low prior-knowledge learners. However, with an annotated network organizer, low and high prior-knowledge learners showed similar learning outcomes.

Keywords: hypertext; graphical organizer; annotation; prior-knowledge

Introduction

Hypertext studies focusing on whether linear, hierarchical, or network/semantic graphical organizers can counteract disorientation and help or hinder learning have yielded mixed results. Hierarchical graphical organizers have repeatedly been shown to have beneficial effects on the learning outcomes of low prior-knowledge learners in comparison with linearly or semantically structured organizers. In contrast, the effect of graphical organizers on learning outcomes of high prior-knowledge learners has at best been inconclusive. Most studies report no differences in learning outcomes for advanced learners irrespective of the graphical organizer offered to them (DeStefano & LeFevre, 2007).

The defining property of any hierarchical structure is that its information is organized in a top-down manner, from general to specific, irrespective of content (Shin, Schallert, & Savenye, 1994). In comparison, a network graphical organizer provides less structural guidance, as a network represents a much less obvious structure (Amadiou, Van Gog, Paas, Tricot, & Mariné, 2009). In a network, any node can be connected to any other node, with the consequence being that the conceptual relationships have to be inferred by the learner. Learning with a network organizer, therefore, requires additional processing which can overburden the cognitive capacities of novices (DeStefano & LeFevre, 2007). For high prior-knowledge learners, this poses less of a problem, as they can consult existing cognitive schemata in their long-term memory to make inferences from ambiguous conceptual relationships. Also, it is often expected that network organizers will benefit high prior-knowledge learners, as a network represents a more complex representation of information than hierarchy. Potelle and Rouette (2003), for example, hypothesised that the categorical knowledge captured in hierarchical structures cannot provide new information to high prior-knowledge learners, whereas a network map displaying causal relationships does so by increasing connectivity within their existing mental models. Contrary

to their expectation, Potelle and Rouette found no significant differences for the effect graphic organizers on learning outcomes of advanced learners.

The ambiguity associated with network organizers can be reduced by explaining the depicted conceptual relationships in them. The present study examined the extent to which explicitly defining the relationships between concepts - in the form of annotations in a hierarchical or network organizer - differentially affects low and high prior-knowledge learners. It was hypothesised that annotations in a network organizer should alleviate its disadvantages for low prior-knowledge learners in comparison with high prior-knowledge learners. In contrast, adding annotations to a hierarchy was not expected to significantly influence learning outcomes, irrespective of prior knowledge. In line with earlier research findings, high prior-knowledge learners were expected to show no significant differences across conditions.

Method

The participants in this experiment were first year university students (mean age = 19.49, $SD = 2.83$; 4 males and 153 females) studying the influence of Cognitivism on Learning and Instructional Science.

The four hypertext environments used in the four conditions of the experiment differed in the structure of the graphical organizer (i.e., hierarchical, network) and in the presence or absence of annotation (i.e., annotated, non-annotated). In one hierarchical and one network organizer, annotations were placed above the lines drawn between concepts, describing the conceptual relationships depicted. The network organizers retained all relationships of the hierarchical organizers, but a number of new, cross-referential relationships were added. Navigation in all conditions was only possible from the graphical organizer to a text node and back. The concepts in the organizers were the hyperlinks which lead to corresponding text nodes.

Fourteen factual and fourteen comprehension multiple-choice questions were used to assess participants' knowledge before and after the learning phase. The multiple-choice questions had four answering possibilities, and were based on the content of the hypertext learning environment.

Preliminary Results

Separate three-way ANOVAs were conducted, with the factors Structure (hierarchical, network), Annotation (no, yes) and Prior-Knowledge (low, high), for factual and comprehension questions respectively. Participants were categorized as belonging to the low and high prior-knowledge group by applying the median split of the pre-test scores.

No significant main or interaction effects were found for factual knowledge. There was a significant three-way interaction for comprehension between Structure, Annotation and Prior-Knowledge (). Low prior-knowledge learners scored significantly higher with a non-annotated hierarchical organizer compared to the non-annotated network organizer (). Furthermore, the low prior-knowledge group scored significantly higher with the non-annotated hierarchical than with the annotated hierarchical organizer (). When comparing the two groups of learners, the high prior-knowledge group scored significantly higher with the annotated hierarchical organizer than low prior knowledge learners (). High prior-knowledge learners also scored higher than low prior-knowledge learners with the non-annotated network organizer () and this difference was significant

The difference between the scores of the two groups of learners in the annotated network condition was not significant.

Discussion

As expected, low prior-knowledge learners had better learning outcomes in the non-annotated hierarchical condition than in the non-annotated network condition. Similarly, the finding that high prior-knowledge learners did not show significant differences across conditions is in line with earlier findings in the literature. It seems, however, that adding annotation to a hierarchical graphical organizer can lead to a measurable difference in learning outcomes. The annotated hierarchical organizer had a negative impact on the scores of low prior-knowledge learners, compared with the non-annotated hierarchical organizer. When the two groups were compared, high prior-knowledge learners scored significantly higher than low prior-knowledge learners in this condition. It seems that annotations in a hierarchy may increase the complexity of the learning material for low prior knowledge learners to such an extent that it overburdens their cognitive resources. In contrast, high prior-knowledge learners seem to be able to successfully deal with such an increase in complexity.

Annotating a network organizer somewhat ameliorated the negative effects associated with network organizers for low prior-knowledge learners. In the annotated network organizer condition, low and high prior-knowledge learners showed similar learning outcomes, whereas high prior-knowledge learners scored significantly higher in the non-annotated network condition. Furthermore, the scores of low prior-knowledge learners were higher with the annotated than with the non-annotated network organizer, although this effect was not significant. It should be also noted that the annotated network organizer still scored lower for low prior-knowledge learners than the non-annotated hierarchical organizer, and led to the *lowest* scores for the high prior-knowledge group. Although these effects were not significant, a word of caution is appropriate here; it seems that the modest increases in learning outcomes associated with the addition of annotation to network organizers might be limited to low prior-knowledge learners. Thus, when it is either not appropriate nor practically feasible to use a hierarchical organizer in hypertext, an annotated network organizer might be a good alternative for this group.

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