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An examination of the effects of argument mapping on students' memory and comprehension performance

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ABSTRACT

Argument mapping (AM) is a method of visually diagramming arguments to allow for easy comprehension of core statements and relations. A series of three experiments compared argument map reading and construction with hierarchical outlining, text summarisation, and text reading as learning methods by examining subsequent memory and comprehension performance. Effects of study environment, argument size, learning strategy (active and passive) and recall interval (immediate and delayed) were also examined. Results revealed that argument map reading and construction significantly increased subsequent immediate recall for arguments in both passive and active learning settings. These findings indicate that AM is a useful learning and teaching methodology, particularly in comparison with standard text-based learning. Results are discussed in light of research and theory on learning and memory.

1. Introduction

As much of the knowledge to be acquired by students in school and university requires reading academic textbooks, an important goal for teachers is to aid students in their acquisition of textbook knowledge. However, for long pieces of text, learning can be difficult because the creation of an integrated representation in long-term memory is constrained by ongoing storage limitations in working memory (Cowan, 2000; Miller, 1956). Some researchers have suggested that because it is too memory intensive to remember everything from a passage of text, a macrostructure, or the 'gist' of the text, is stored in long-term memory, and this represents the summary information a reader considers important (Kintsch & van Dijk, 1978). Hence, it is this macrostructure, and not the original text that the reader remembers when later asked to recall the text (Kintsch & van Dijk, 1978). The problem with this learning strategy is that although the formulation of a macrostructure presumably facilitates recall of information, it is likely that information is not encoded at a very deep level of specificity; in other words, the detail of propositions and of relations between propositions will probably not be remembered.

Various organisational strategies have been devised to enhance long-term retention of information, including, for example, summarisation (Kintsch & van Dijk, 1978), hierarchical summarisation (Taylor, 1982) and graphic organisation (Robinson & Kiewra, 1995). Research suggests that when to-be-remembered information is presented in a well-organised manner, the level of free recall is better than when it is presented in a random order (Bower, Clark, Lesgold, & Winzenz, 1969; Myers, 1974). Also, readers who are sensitive to text structure recall more information than readers who are not (Meyer, Brandt, & Bluth, 1980).

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Hierarchical summarisation is an explicit, active organisational strategy. It involves extracting and summarising the key themes and sub-themes in a text. Taylor (1982) found that the use of hierarchical summarisation (more commonly known as outlining), increased recall of text in students who were trained in the use of the technique. A similar study by Berkowitz (1986) provides a rare example of how organisational strategies can be used to facilitate learning of prose arguments. Berkowitz taught students to construct maps of prose passages. Using this mapping strategy, the main ideas from the passages were summarised in separate boxes and supporting claims were listed as bullet points beneath each of the main ideas. The boxes were organised in a radial structure (i.e. around a central claim). Berkowitz found that for students who used this technique overall recall of passages was significantly improved relative to students who used traditional study techniques (i.e. question-answering and re-reading procedures).

Although Berkowitz described her maps as a graphic representation of the superordinate and some of the more important subordinate ideas in a passage, organised in a manner similar to the way the author organised them in the original selection, the propositional content of the radial maps did not represent fully planned arguments. Also, although Berkowitz attempted to construct maps that corresponded to the way the author organised ideas in the original selection, the radial structures in no way reflected the structure of the argument (see Twardy, 2004 for a discussion of the text to argument map translation process). Therefore, a critical question is whether or not the reading and construction of more explicit, complete, logical, hierarchically structured maps that faithfully represent the structure of an argument can be used as part of a package of classroom learning activities to facilitate students' assimilation of and memory for arguments. One such organisational strategy developed quite recently and that shows particular promise in this regard is argument mapping (e.g. van Gelder, 2000, 2007).

Argument mapping (AM) is a method of visually diagramming arguments in an organised hierarchy, in order to simplify the reading of an argument structure and allow for easy assimilation of core propositions and relations. The AM uses a 'box-and-arrow' design in which boxes represent propositions within an argument while arrows make the inferential relationships between these propositions explicit (see Fig. 1 for an example). Boxes are colour-coded to indicate the nature of propositions (e.g. reasons, objections, and rebuttals), and arrows are labelled so as to specify the nature of the relationship between the propositions (e.g. *but*, *because* or *however*). The use of coloured boxes, arrows connecting boxes, and semantic cues describing relations between propositions are all designed to 'glue' the structure of the argument together and allow the reader to analyse and evaluate a line of reasoning with ease. This system of representation may therefore help to reduce the burden associated with analysing and evaluating text-based argument structures and facilitate subsequent memory and comprehension.

More specifically, when it comes to analysing arguments, the problem with traditional text-based learning is that it does not allow one to readily connect statements that support and dispute specific reasons. The learner must engage in a cognitively demanding process of linking propositions that are located in different paragraphs, on different pages, and so on. When reading a text-based argument, the reader must mentally construct the argument, thus switching attention away from the information presented in the text. In a series of seminal studies, Pollock, Chandler, and Sweller (2002) found that learning is impeded when instructional materials require a high degree of attention switching, for example, between text and figures. They concluded, more generally, that encoding environments that increase the cognitive load placed on the reader tend not only to slow the learning process, but also reduce overall levels of learning.

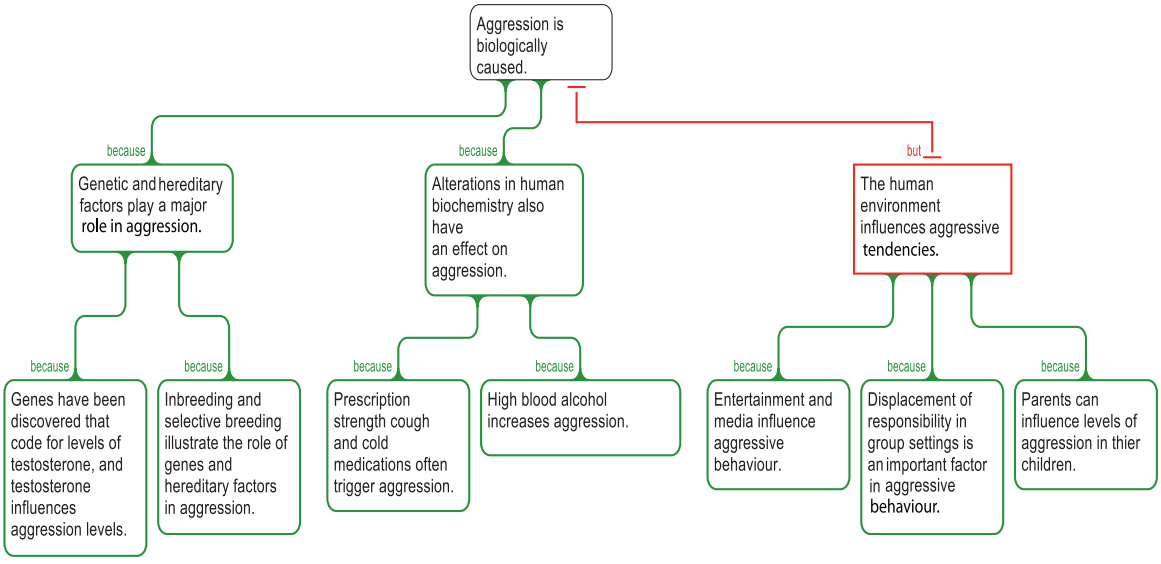

Fig. 1. An example of an argument map built using Rationale™.