ELSEVIER

Learning and Instruction 15 (2005) 281–296

Learning and Instruction

www.elsevier.com/locate/learninstruc

Concepts and misconceptions in comprehension of hierarchical graphs☆

Christof Körner*

Institut für Psychologie, Karl-Franzens-Universität Graz, Universitätstplatz 2/III, A-8010 Graz, Austria

Abstract

Hierarchical graphs represent relationships between objects (like computer file systems, family trees etc.). Graph nodes represent the objects and interconnecting lines represent the relationships. In two experiments we investigated what concepts are necessary for understanding hierarchical graphs, what misconceptions evolve when some of the concepts are missing and how misconceptions can be prevented through instruction. Participants were taught different amounts of prior knowledge and then had to respond to a multiple-choice questionnaire with interpretive questions about graphs. In Experiment 1, 72 university students received different amounts of instruction about the concepts necessary to interpret hierarchical graphs. Through detailed analysis of readers' wrong responses to interpretive questions we identified a set of misconceptions. Participants maintained fewer misconceptions and performed better if they had been taught more conceptual knowledge. However, their overall performance was poor. In Experiment 2, 85 students were informed about possible misconceptions, in addition to the instruction of conceptual knowledge. With this intervention they obtained an acceptable level of understanding of hierarchical graphs. The discussion of the results draws on theoretical considerations for the evolvement of misconceptions such as

☆ Supported by grant 8419 of the Austrian National Bank (OeNB) to the author. I thank Edith Schreiner for collecting the data.

* Tel.: +43 316 380 5108; fax: +43 316 380 9806.
E-mail address: christof.koerner@uni-graz.at

0959-4752/$ - see front matter
doi:10.1016/j.learninstruc.2005.07.003

failure to integrate visual and conceptual information and context specificity of the representation.

Hierarchical graphs represent the relationships between nonnumerical entities or concepts (Butler, 1993). Examples of hierarchical graphs include the structure of computer file systems, preference trees, organisation charts, family trees, and other sorts of conceptual information. Fig. 1 shows an example of a hierarchical graph that represents a hypothetical person's preferences for beverages.

The usefulness of graphs and diagrams for visualisation has often been reported when readers have to learn from texts (e.g., Hegarty & Just, 1993; Mayer & Gallini, 1990; Schnotz & Bannert, 2003; Schnotz, Bannert, & Seufert, 2002). Educators in mathematics have pointed out the importance of teaching students how to interpret diagrams as well as how to produce diagrams from texts (e.g., Barwise & Etchemendy, 1991; Goldin, 1985; Lewis, 1989; Silver, 1982). Novick (2001), Novick and Hmelo (1994), Novick and Hurley (2001), and Novick, Hurley, and Francis (1999) have repeatedly demonstrated the important role of such graphs and diagrams in communication, problem solving and thinking.

Körner (2004) and Körner and Albert (2002b) have recommended design criteria that help optimise hierarchical graph comprehension. In their experiments they relied on response time and eye movement analysis when readers were instructed and trained with the appropriate knowledge to interpret the graphs correctly.

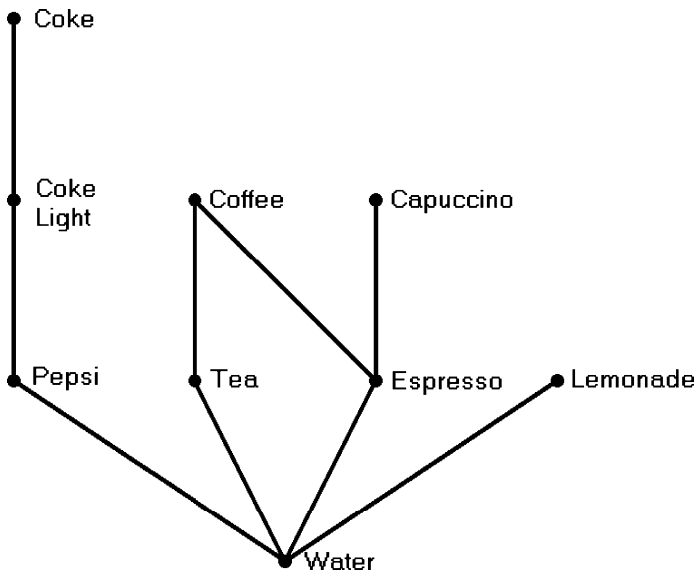

Fig. 1. Example of a hierarchical graph showing preferences between beverages.