Chapter 11
Using Eye-Tracking Technology to Understand How Graphic Organizers Aid Student Learning

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ABSTRACT

In the past three decades, several studies have found an achievement advantage for studying graphic organizers such as a hierarchy or matrix over studying linear displays such as a text or outline (e.g., Dye, 2000; Guri-Rosenblit, 1989; Kauffman & Kiewra, 2010). However, little was learned about how students study graphic organizers and the cognitive processes involved. Recently, the advancement of eye-tracking technology has provided a means to examine how students actually study graphic organizers and the types of processing that occur. The purpose of this chapter is to explore how eye-tracking technology can be used to understand how graphic organizers aid student learning. Specifically, this chapter introduces graphic organizer research and theory, reviews recent research that used eye-tracking technology to study graphic organizers, and offers future research directions.

INTRODUCTION

Although it has long been established that studying graphic organizers such as hierarchies or matrices results in higher achievement than studying linear text such as outlines (e.g., Dee-Lucas & Larkin, 1995; Guri-Rosenblit, 1989; Kauffman & Kiewra, 2010; Robinson, 1998), little is known about how graphic organizers are actually studied. More recently, investigators have used eye-tracking methods to determine how students study graphic organizers (e.g., Luo, Peteranetz, Flanigan, Witte, & Kiewra, 2014; Ponce & Mayer, 2014a, b; Salmerón, Baccino, Cañas, Madrid, & Fajardo, 2009). The purpose

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of this chapter is to describe how eye-tracking technology is used to investigate how students study graphic organizers and to report what has been found. Toward that end, this chapter:

1. Introduces graphic organizers,
2. Reviews graphic organizer research and theory,
3. Specifies research limitations and the need for eye-tracking technology,
4. Reviews eye tracking in educational research,
5. Explores eye-tracking methods and findings related expressly to the study of graphic organizers, and
6. Identifies research limitations and proposes future research directions.

An Introduction to Graphic Organizers

Instructional information is commonly displayed in block form as shown in the paragraphs in Figure 1 about the solar system's first two planets. Alternatively, information is also commonly displayed in linear form as shown in the outline in Figure 2 for the solar system's next two planets. The problem with these common displays is that they obscure relationships. In this case, studying blocks or lines of planet information makes it difficult to recognize relationships among planets. For example, a learner would need to scan back and forth between paragraphs or between outline sections in order to compare information about the two planets being described.

It is also possible to display the planet information in a more graphic form. Graphic organizers display information more visually than conventional text and outlines. Graphic organizers compress seemingly disjointed information and convert it into a spatial structure that is easy to read and understand. A good graphic organizer reveals the intended message and the important relationships with only a glance (Guthrie & Taboada, 2004; Jonassen, Beissner, & Yacci, 1993; Robinson & Kiewra, 1995; Winn, 1991).

A more graphic display of the solar system information appears in Figure 3. This matrix organizer is superior to its block and linear form counterparts because it prompts planet comparisons and reveals integral relationships obscured by the competing forms. Rather than forcing a learner to jump back and forth between separate paragraphs or outline sections, a matrix places all related information together for easy comparison. With only a glance at the matrix, several planetary relationships are quickly revealed: As planets are positioned farther from the sun, revolution time

Figure 1. Planets text

Mercury is 36 million miles from the sun. Its revolution time around the sun is 3 months. Its orbit speed is 30 miles per second. Its diameter is 3,000 miles. Mercury has a rocky surface. It has 0 moons. Its rotation time is 59 days.

Venus is 67 million miles from the sun. Its revolution time around the sun is 8 months. Its orbit speed is 22 miles per second. Its diameter is 8,000 miles. Venus has a rocky surface. It has 0 moons. Its rotation time is 243 days.