

Part II

Current Educational Research

Although solutions to the many unanswered problems of cognitive psychology would assist educational researchers to refine their work on visualization, important research can still be done in their absence. Acknowledging the many unknowns, educationalists have forged ahead and have produced many important results regarding the use of visualization in mathematics, reading, and science education, though there appear to be fundamental differences in the ways that visualization is currently used in these three areas. These differences are largely due to the different purposes to which visualization is put in these subject areas. In mathematics, as shown in [Chapter 5](#), the bulk of the research is aimed at visualization as a computational aid, as suggested by the visual imagery hypothesis. In mathematics, such visualization often leads to the creation of new mathematics. One could use a visualization object to assist students to understand a mathematical object, which could lead to the creation of another object that is mathematically interesting in its own right. For example, a graph might be used to help a student to understand a function. The graph itself, however, is a new mathematical object with its own properties. It is then possible for the educator or educational researcher to take an interest in graphs that is independent of the original aim of the graph's introduction. The role and effectiveness of visualizations in mathematics is both contentious and ambiguous. The contention arises from the belief by many mathematicians that visualizations tie universal mathematical concepts and thoughts inappropriately to specific objects, thereby misleading students about the significance of the mathematical results. The ambiguity arises because the best mathematicians often are not the best visualizers. The question arises whether it is the nature of the curriculum rather than of mathematicians that separates these two groups.

A main goal of reading is the interpretation of text, so visualization objects often are used with the aim of assisting the reader to make sense of written material. To be sure, there is much to be said about interpretation of images as adjuncts to text, by which here we mean the printed word, but often the point of reading is the interpretation of text, making the visualization object a means to that end. Not surprisingly, then, much of the research on visualization in reading follows the lines of dual coding theory, as suggested in [Chapter 3](#). A main finding presented in [Chapter 6](#) is that visualizations can assist with reading but only for students who have been provided explicit instruction in their use.

In science, as shown in [Chapter 7](#), the situation differs again. Visualization objects in science are sometimes used to illuminate particular features of an object of scientific study. Anatomical diagrams are of this sort: the point of the diagram is to assist the student to identify some salient features of the object of the diagram. Many scientific visualization objects, however, are schematic rather than realistic. In these cases, the point of the diagram is to assist in calculations or descriptions of some phenomenon or process. Electrical circuit diagrams are a case in point. There is no information in a circuit diagram telling students what electrical circuits or components look like. The point of the circuit diagram is to show how the circuit is built. The benefit of the circuit diagram is that it allows one to give a description of a number of related properties and events in a working circuit. Visualization research in science education is informed by either dual coding theory or the visual imagery hypothesis. We did not find research that is informed by both.

The following three chapters on mathematics, reading, and science education are discussed separately for purposes of organization. However, they are not intended to be mutually exclusive.