Chapter 6
A Multimedia Learning Tool that Allows High School Teachers and their Students to Engage in Scientific Research

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ABSTRACT

This chapter presents a new and different type of multimedia learning tool, the so-called "research module." This unique, learner-centered, multimedia tool aims to create a learning environment wherein high school teachers and their students engage in higher-order, inquiry-based activities that allow them to "do" actual scientific research in the classroom. This chapter also describes the design and implementation of these computer-based resources, as well as assessment data on student learning, and perceptions of both textbooks and computer-based learning tools. It also reveals high school teachers' attitudes toward the use of both computer-based resources and textbooks.

Scientific inquiry refers to the diverse ways in which "scientists" study the natural world and propose explanations based on the evidence derived from their work. Inquiry also refers to the activities of "students" in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world. (National Science Education Standards, p. 23.)

INTRODUCTION

Can technology change the way science is taught? The answer is yes. Strategically designed interactive technology is allowing us to link skilled educators and research scientists from around the world with high school teachers for professional development, and with their students for high impact, or higher-end inquiry learning. In short, technology is allowing us to build new and effective multimedia learning tools and strategies for the 21st Century classroom, which bring real-world research experiences to life for teachers and students.

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Technology is helping biology instructors redefine their "pedagogical toolboxes" for the 21st Century classroom. Indeed, new, technology-centered, *multimedia learning* tools are evolving, and through their evolution, are allowing instructors to re-imagine the endless possibilities for teaching in innovative and exciting ways. Moreover, they are creating interactive classrooms, empowering instructors to be facilitators of learning, and helping to excite the next generation of researchers and scientifically aware citizens.

Definitions

According to Mayer (2001), the term *multimedia* means the presentation of material using both words and pictures. The words can be printed (e.g., on-screen text) or spoken (e.g., narration). The pictures can be static (e.g., illustrations, graphs, charts, photos, or maps) or dynamic (e.g., animation, video, or interactive illustrations). This definition is broad enough to cover a textbook, a computer-based narrated animation, and a "research module" – which you will read about herein.

Mayer and his associates have been carrying out research for years to figure out how to best use words and pictures to foster meaningful learning. In fact, they have proposed a "Cognitive Theory of Multimedia Learning" to explain how the mind works in multimedia learning (Mayer and Moreno, 1999). According to Mayer, *multimedia learning* refers to learning elicited by words and pictures, and *multimedia instruction* is the presentation of words and pictures that are intended to foster learning. Importantly, there are two contrasting views of multimedia learning – *multimedia learning as information acquisition* and *multimedia learning as knowledge construction.*

Basically, if you view multimedia learning as information acquisition, then multimedia is merely an information delivery system. According to this viewpoint, learning simply involves adding information to a student's memory bank. Not surprisingly, the information acquisition view is sometimes called the "empty vessel" view because the learner's mind is seen as an empty container that needs to be filled by the teacher pouring in the information.

In contrast, if you view multimedia learning as knowledge construction, then multimedia is a cognitive aid (think of yourself as an architect). According to this view, multimedia learning is a sense-making activity in which the learner seeks to build a coherent mental representation from the presented material. Unlike information, which is an objective commodity that can be moved from one mind to another, knowledge is personally constructed by the learner and cannot be delivered in exact form from one mind to another. In this view, the teacher functions as a facilitator who provides guidance to frame and support the learner's cognitive processing. The responsibility for learning shifts to the student, and the teacher becomes the guide who highlights what to pay attention to, how to mentally organize the information, and how to make it relate to prior knowledge. As Mayer's states, the teacher here is "an aid to knowledge construction."

Mayer, like myself, favors the knowledge-construction viewpoint because it is more aligned with the research base of how people learn (Bradsford et al., 1999). The knowledge-construction view of multimedia learning is consistent with our mutual goal of using multimedia in the classroom – to help students develop an "understanding" of the presented material rather than exposing students to, and overloading them to, vast quantities of information. Importantly, Mayer, also supports, as I do, "*learner-centered*" rather than "*technology-centered*" *multimedia approaches* when it comes to multimedia design for student learning (Mayer, 2009). Learner-centered approaches begin with an understanding of how the human mind works and ask, "How can we adapt multimedia technology as an aid to human cognition?" In contrast, technology-centered multimedia approaches begin with the functional capabilities of multimedia