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# Looking Back Towards the Future?

## Paper Presentation

### INTEGRATING MULTIMEDIA REPRESENTATIONS IN ONLINE EDUCATIONAL TECHNOLOGY COURSES

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#### Abstract

Multimedia representations are used in online courses to enhance communication and instruction. By taking advantage of the properties of multiple representations, it is possible to explain concepts and processes more effectively for distance students. Benefits and problems associated with multimedia representations are described. Working examples from an online educational technology program are discussed and links are provided.

A representation is something used to stand for something else. In semiotics a representation may be regarded as a sign or meaningful unit found in the form of words, images, sounds, acts, or objects (Chandler, 2002). Representations are vehicles of communication.

The act of teaching involves communication and the use of representations. When a teacher stands before a classroom to explain how to solve a quadratic equation words and mathematical symbols will most likely be used to communicate the process. The representations are then received by learners who process and interpret those representations in their own way.

Representations are also used by instructors in the online course to communicate information. Representations are the metaphorical bricks used to construct course content. In a completely asynchronous online course the representations are chosen, created, and combined to form instructional content which is posted on a course web site for students to access at various times. When students open the course site, they read, process, and interpret these representations displayed on their computer monitors. Since students are separated from the instructor, the quality of course content is magnified. If students are confused or have questions, they cannot raise their hands and obtain an immediate response as they might in a face to face classroom. Instead, questions are most likely asked through email or course discussion forums. This type of communication between student and instructor tends to involve a time lapse.

For example, it is possible for a student to send an email asking for help and wait hours or days to receive a reply. While the time lapse problem may not be entirely avoided, it might be minimized through effective use of representations to communicate information to students.

#### Combining Representations to Enhance Meaning

Representations come in a variety of forms, each having different properties. Text, images, tables, audio, animations, video, or interactive components are all different categories of representation that may be used for different purposes when teaching online (Snelson, 2005). For example, verbal text is used in an online course to represent ideas or instructions normally communicated in spoken language form during a face to face class experience. Text can be used quite effectively on its own. However, there are times when the information in text can be clarified or enhanced by combining it with other representations such as images. An image can be used to capture specific elements of spatial information more effectively than text. In Figure 1, text has been combined with an image of the login screen for a course web site. The image provides more specific information because it shows an exact representation of the login screen and the fields where login information should be typed. When the student visits the login page, this image looks like the display they will see. The text and image combination provides clearer information due to the combined properties of the two forms of representation.



Figure 1. Login Screen for a Course Web Site

When multiple representations are combined as they have been in Figure 1, a system of representations is formed (Goldin & Shteingold, 2001). Within a system each representation may function to complement other representations, constrain misunderstanding, or assist learners while constructing abstract ideas (Ainsworth, 1999). In Figure 1, the text and image represent information in complementary verbal and spatial forms. They also constrain or inhibit misinterpretation of where exactly to type login information. The combination of multiple forms of representation can therefore be used to communicate more effectively.

### Advantages and Disadvantages of Multiple Representations

While designing instructional materials, one may take advantage of the properties of various forms of representation to enhance clarity of the information (Palmer, 1978). This idea is particularly relevant when designing instructional messages, which are created when a combination of representations are combined into a meaningful unit of information (Fleming & Levie, 1993). Instructional messages are a subset of a full lesson. Representations are used to create instructional messages, and instructional messages are combined into larger blocks of instructional content. Since the online course is hosted in an electronic environment, the array of representations and their associated properties is greater than would be possible in a more static form such as a printed textbook. Dynamic multimedia representations such as audio, animation, video, and interactive elements may be used to develop effective instructional messages that have the potential to improve student learning (Mayer, 2001). Additional benefits of multimedia enhanced instruction described in the research literature include increased student interest (Yaverbaum, Kulkarni, & Wood, 1997), reduced cognitive load (Mayer & Moreno, 2003), and improved understanding of abstract concepts (Lai, 2000).

There is some debate over the effectiveness of multiple representations and multimedia learning in the research literature. Ainsworth, Bibby, and Wood (2002; 1997) have described difficulties encountered by learners who work with multiple representations in mathematics. If the relationship between representations is unclear, the benefit of multiple representations can be lost. There is a potential to reduce this problem through the use of technology that dynamically links representations. Computer software can be used to connect two representations such as a mathematical equation and its graph so that when one representation changes the other changes in response.

### Multimedia Representations and Online Educational Technology Instruction

The reported difficulty that sometimes occurs when translating between multiple representations may be affected by the underlying knowledge domain. In mathematics, it is possible for a novice learner to be unfamiliar with all of the representations used as well as the mathematical concepts being represented. In other knowledge domains, it may be easier to combine multiple representations in a way that effectively communicates concepts or processes. This can be accomplished by grounding at least one of the representations in a familiar realm. Screen captures of software used by students in an online educational technology course would be an example of this. Since the students own the software, it is familiar to them. The software can be opened and its features matched to corresponding elements in the screen capture images. New information described in the online instruction can be assimilated in the context of the familiar software program.

To explore this idea further, consider a task where students have been asked to hand code a basic web page. In this task students are asked to type HTML text directly into the software used to build web pages. There are several ways that instructions for this task could be developed. One way is to type a set of steps in text only. The text directions may help students to some degree, but there is no representation available to allow them to see what it is supposed to look like when they click buttons or add the code. Another approach could be to add screen capture images to the text to show a set of steps to follow. This would enable the students to see what the software should look like as they progress through the task. In a

multi-step process many images may be required to provide snapshots in time throughout the entire process. This set of images and text could be combined in a collection of instructions to create a downloadable handout for students, but the information would be static. An animation would be needed to fully capture the entire process showing mouse movement, button clicks, and typing. If both forms are made available to students, they may view the process via animation and use the images and text to prompt them while they work through the process independently. A link to a working example of this type of animation and handout is available in Table 1.

Table 1.  
*Example of an Animation and Downloadable Handout*

A working example of an animation and downloadable handout is available online at:  
<http://edtech2.boisestate.edu/snelsonc/common/dreamweaverhtml.htm>

One of the representational properties of animations is the ability to capture motion as illustrated by the working example linked above. Animations are also useful for drawing attention to features of an image during an online presentation. The eye tends to follow the motion of elements moving on the screen. Audio may be combined with animation to take advantage of dual coding between visual and auditory sensory systems (Add Paivio reference). In an online environment, audio can be coupled with animation to create presentations that target specific concepts students might have trouble understanding. A working example will help to illustrate this idea. A link to this example is in Table 2. This presentation was prepared to clarify an illustration from a course textbook. An animation is used to highlight portions of the illustration as they are being described in the audio.

Table 2.  
*Example of Animation With Audio*

A working example of an animation synchronized with audio is available online at:  
<http://edtech2.boisestate.edu/snelsonc/common/cognitive-Mayer.htm>

## **Technological Aspects of Multimedia Representations**

The two animation examples linked from Tables 1 and 2 were created with software that produces a Flash movie output. Macromedia Captivate was used to produce the animation in Table 1 and an earlier version of this software called RoboDemo was used to produce the animation in Table 2. The Macromedia Flash player is used to play these animations from web pages that they are embedded in. The file sizes for Flash animations tend to be small and the files are compatible with most machines. This makes the animations accessible to most students enrolled in an online program.

## **Conclusions and Research Implications**

There is some support for the idea that multimedia may be used to represent ideas and positively impact student learning (Mayer, 2001). Results of controlled experiments have been favorable. Yet, there are still many unknowns regarding the use of multimedia representations in the messy world of online teaching and learning. Future research that explores the use of multimedia in online instruction would serve to illuminate factors that either benefit or hinder learning when multimedia is involved. This research could build on past multimedia learning research to explore its impact on learning in the synchronous online course. Through this line of research new insights may be gained into the fundamental nature of learning through multiple representations.

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