Research on Multimedia Learning Theory: An Annotated Bibliography

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Introduction

The cognitive theory of multimedia learning states that when students are presented with words and graphics in a well-designed format then they retain information at higher levels. This increased learning is due to the use of the dual channel and limited capacity principles in the design process which has been proven to foster active processing by limiting cognitive load. The state of active processing occurs when a learner concentrates on the material and then selects, organizes, and integrates that information with prior knowledge thus forming a new mental model (Clark & Mayer, 2011, p. 36). In other words, active processing is the cognitive state where “meaningful learning occurs” (p. 37).

The following research is related to the theory and was conducted within the last fifteen years. All sources are peer-reviewed books or journal articles. The topics discussed are emotional design, cognitive architectures, multimedia learning systems, interactivity, and hypermedia. The focus of the final paper will be narrowed and cover the specific topic of interactivity.

1. *Emotional design in multimedia learning* (Um et al., 2012).

   This work describes the important role that emotions play in multimedia learning. As stated by the authors, this proposition runs counter to cognitive load theory which considers emotions as extraneous variables that should be controlled because they interfere with the learning process. This article does not agree with that premise and states in the hypothesis that “the use of design features to induce positive emotions in learners will result in increased learning…and higher satisfaction with the learning experience” (p. 487).
The results of the research, which tested 118 undergraduate students, found that when emotional aspects were added to the design learners reported that the experience was more positive when compared to a non-emotional design. In the conclusion, the researchers stated that when designers add positive interaction to the multimedia presentation, such as providing encouraging feedback and coaching, then this has a positive influence on learning (p. 492). After reading the study, I learned that taking the emotional state of the learner into consideration when designing multimedia learning systems is a necessary practice for success.

2. Cognitive architectures for multimedia learning (Reed, 2006).

The fundamental theories related to multimedia learning were explained and discussed in this paper. These six theories are Paivio’s (1969) dual coding theory, Baddely and Hitch’s (1974) working memory model, Engelkamp’s (1998) multimodal theory, Sweller’s (1988) cognitive load theory, Mayer’s (2001) multimedia theory, and Nathan’s (1992) ANIMATE theory. In the conclusion section, the author mentioned that facilitators should extrapolate information from all of these theories when designing a multimedia product (p. 97). For a researcher just beginning in this area of study this article is extremely valuable because it describes in a clear and concise manner many of the most important principles of multimedia learning theory.


This article discussed the planning, design, development, implementation, and evaluation methods used in multimedia learning systems. The authors stated that for these systems to be considered pedagogically sound it “requires well-planned and skillfully written content, attractive and functional graphic design and rapid implementation at a reasonable and affordable cost” (p. 28). This is accomplished by having an “innovative creative design, precise artistic direction, and strict hands-on project management” (p. 29). The paper also went into detail about
the instructional design process of constructing a multimedia product. This description included the needs analysis, learner analysis, content analysis, formative evaluation, course framework design, and implementation (p. 30).

The course framework design section featured the pedagogic and microdesign elements of the process. The pedagogic aspect focuses on the satisfaction of the learning objectives and describes in detail how to “set the criteria for measuring the learning outcomes.” For the designer, this activity “involves [creating] opportunities for active learning and…student interaction to be carried out in an on-line environment” (p. 34). The microdesign is considered the overall aesthetics, interactivity, and functionality of the product. As stated by the authors, an exemplary microdesign is one that is easy to use, interactive, stimulating, inspiring, and serves some practical purpose (p. 35). This is the section of the paper that I found the most informative because pedagogy and microdesign are the two most important parts of multimedia design.


This study of 33 university level students in the UK tested for the presence of an interactivity effect within a multimedia presentation (p. 1149). The interactivity effect happens when interactive elements are added to the multimedia product and then learners become engaged in the process and because of that are more likely to have a successful learning experience. The experiment split the participants into two groups, a control and tested group, and then the researchers administered a computer-based program that had either interactive or non-interactive elements. At the end of the study, the researchers concluded that the “test scores suggest that adding interactivity to a computer-based lesson increase[s] the depth of learning or understanding” (p. 1156). This result is good information for instructional designers to know as interactivity appears to be a necessary element for successful multimedia learning.

As defined by the authors in the paper, the term interactivity is considered a “reciprocal activity between a learner and a multimedia learning system, in which the [re]action of the learner is dependent upon the [re]action of the systems and vice versa” (p. 1025). In this article, the integrated model of multimedia interactivity, or INTERACT, was presented. This holistic model is “a new model…which integrates the affordances of the medium and the activities of the learner” (p. 1032). In addition, the model is comprised of six components that are important factors to consider when designing an interactive multimedia environment. These components are the “learning environment, behavioral activities, cognitive and metacognitive activities, motivation and emotion, learner variables, and the learner’s mental model” (p. 1026).

In the conclusion, the author’s stated that the “model provides educators and educational designers with a process approach that allows them to design and evaluate specific interactive components for their multimedia applications” (p. 1032). This novel theory encompasses all aspects of the multimedia learning process, from the learning environment to the emotions of the learners, and could be considered a standard model for creating interactive multimedia.

6. *Interactive multimedia and learning: Realizing the benefits* (Cairncross & Mannion, 2001).

This paper discussed the potential benefits of using interactive multimedia in order to create “high quality learning environments.” The main premise of the article is that multimedia has not been used within the educational system in the proper way because some of the important elements of design, such as delivery control, access routes, individual differences, and interactivity, are often overlooked in the process (p. 156). In the final analysis, the authors stated that “interactivity in learning applications merits more detailed investigation and the issue of how best to design learning activities that engage the user needs to be addressed” (p. 163).

Solutions related to coherence and metacognition of hypermedia were introduced in this article. The intention of these various solutions is to “guide hypertext development geared toward improving…engagement” (p. 1). The reason for these interventions is that some hypermedia designs can easily confuse learners if it is not organized coherently. This incoherence prevents proper metacognition of the material which affects learning. The author’s mentioned a few solutions to these issues. One is to “provide well-defined, goal appropriate global structure for domain novices” (p. 18). This is for newbies to hypermedia and simply means that for these type learners the design should be coherent and easy to negotiate. Another valuable tip is to “highlight links that denote very important inter-document relationships” (p. 20). This is done so learners are well-aware of the relationships between the most primary documents that are required.

In conclusion, this article was enlightening as it illustrated the importance of coherence and metacognition in the design of hypermedia documents and offered some solutions. As the author’s summarized, “in an ideal world, all learners would have enough metacognitive skill to create coherence between documents, but that simply is not reality for a vast majority of learners” (p. 21). This is great information to apply to all future hypermedia design projects.
References


