# A CRITICAL DISCOURSE IN MULTIMEDIA DESIGN: A PEDAGOGICAL PERSPECTIVE TO CREATING ENGAGING ONLINE COURSEWARE

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## Abstract

Development of interactive e-learning courseware has focused largely on the instructional design approach of multimedia applications and has brought about a substantial amount of success in producing engaging multimedia educational resources. In this article I explore how the multimedia instructional strategies and processes can be enhanced by incorporating the principles of cognitive psychology in the design phases. Human cognitive architecture involves both, a limited working memory with visual and auditory channels, and a permanent long-term memory for storing multiple schemas. Understanding and tapping the rich potencies afforded by the human cognitive architecture would result in a more purposeful instructional program embedded in multimedia-mediated learning environments.

**A critical discourse in multimedia design: A pedagogical perspective to creating engaging online courseware**

E-learning has gained immense popularity in recent times. Debunking traditional notions of how teaching and learning have been taking place in educational ecology, e-learning has bridged the constraints of time and geographical distance that hampered learning, to instead afford a flexible yet dynamic mode of study for populations of learners, taking into account their varied learning styles and needs. E-learning is now widely hailed and synonymously associated with better and more efficient learning outcomes. But is this merely hyped up propaganda?

In this regard, numerous studies have been undertaken to analyse and evaluate the efficiency of e-learning environments. Kulik and Kulik (1991) related an improvement in knowledge appropriation when learning is advanced through computer-based tools as compared to traditional learning styles. Similar results have been reported in the use of computer technology to enhance the learning processes in schools (Software Publishers Association 1995) and universities (Kazmerski and Blasko 1999, Steyn, du Toit et al. 1999). Interestingly other studies have shown different outcomes in the integration of technology in educational settings. Fricke (1991) found only slight, or no differences. In their study, Merchant, Kreie et al. (2001) investigated  multimedia computer based training (CBT) which was determined to be less effective than normal instructional modes. I could surmise from these findings, that more often than not, blind development and usage of e-learning courseware, devoid of the sound theoretical underpinnings that drive e-learning pedagogy, would not auger well in promoting authentic learning. Instead it could have the negative ramification of suppressing learning outcomes. E-learning models based upon sound instructional strategies that are couched in the philosophy that learners learn *with technology* and not *from technology,* would surely help to advance the cause of learning mediated by technology. In the name of e-learning often the emphasis has been anchored on the clarion call for pervasive and often indiscriminate integration of technological tools in

teaching and learning. E-learning has more to do with appropriate and judicious harnessing of technology to realize positive learning gains This avoids the pitfall of delivering e-learning materials that are pedestrian, insipid, second-guessable and most crucially, fail to impact on the learners' cognitive development.

## Multimedia in e-learning

Multimedia is the use of text, graphics, animation, pictures, videos and sound to present information (Bagui, 1998). Multimedia involves the simultaneous use of multiple media formats (Hede & Hede, 2002).

The role of multimedia in the instructional design of e-learning materials cannot be undermined. Its influence on the design processes of digital educational content-ware has been given increasing emphasis and much research has been undertaken in recent times to study the results of effective multimedia usage to enhance online learning productivity and optimize learners' cognitive development. However this field of study is still very much in its infancy and no definitive, theoretical base of evidence on its effectiveness has been established (Beccue, Villa & Whitley, 2001).

Although multimedia learning offers immense potential for scaffolding learners' educational progress and charting their learning curves effectively through immersion in authentic learning environments and simulations, caution must be sounded that automatic inclusion of multimedia effects alone do not ensure learner success. Cuban (1986) emphasizes that merely adopting a technology-centric educational strategy would not necessarily guarantee proper learning goals and processes. Cutting-edge technologies of the era would not reap windfalls in terms of positive learning outcomes unless a learner-centered perspective to teaching and learning is embraced as the underpinning pedagogy. Technology has to be adjusted to fit the learning patterns of users (Norman, 1993).

## Integrated model of multimedia effects on learning

Some of the sound pedagogical and psychological principals that predicate an efficacious multimedia design model to inform e-learning developers on how to maximize the learning of intended users will be investigated in this article. The developmental framework for delivering sound e-learning instructional materials grounded in engaging multimedia effects is guided by the integrated model of multimedia effects on learning proposed by Hede and Hede (2002) and illustrated in the figure below.

Figure 1

**Integrated model of multimedia effects on learning[1]**
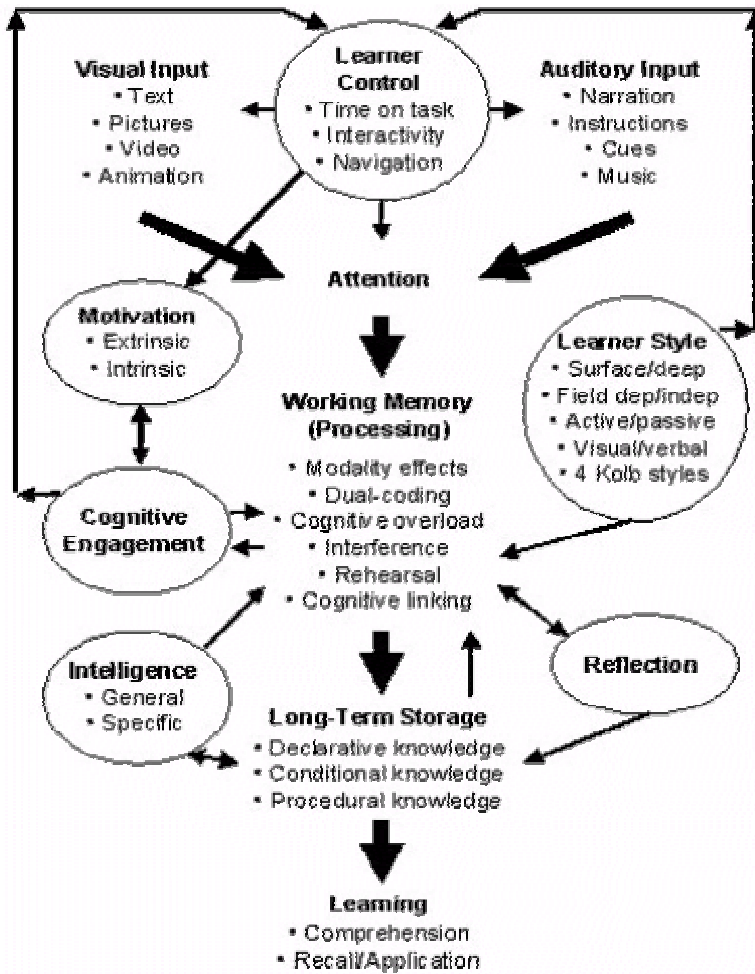


The Hede and Hede (2002) model highlights at least 12 multiple factors and their complex interactions that multimedia and e-learning designers need to be aware of to account for multimedia effects on learning. This paper focuses on visual and auditory effects based upon established cognitive psychology principles that scaffold the development of authentic e-learning content-ware.

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[1]From "Multimedia effects on learning: Design implications of an integrated model" by Hede, T., & Hede, Andy, 2002, ASET.

**Human cognitive architectures**

Cognitive architecture refers to how cognitive structures are organized and managed. Sweller (2002) explains some of the aspects of human cognitive architecture related to visual and oral based multimedia instructional design processes.

Working memory (Baddeley & Hitch, 1974) deals with the consciousness of our everyday lives. It is the next destination during the flow of information on its cognitive processing journey which begins with the information entering the eyes and ears then being briefly stored in the visual and auditory sensory system. Working memory is the centre of cognition and scaffolds all the active thinking activities that occur (Clark & Mayer, 2003). Though powerful as a cognitive processing tool, the

working memory is however inhibited by its limited capacity (Miller, 1956) and limited duration (Peterson & Peterson, 1959).

Long term memory is the final stop in the cognitive information processing conduit wherein the information is permanently stored (Shiffrin & Atkinson, 1969). Learning entails new abilities and skill-sets being processed in the working memory and integrated with existing knowledge models in long-term memory. Integration of new knowledge from working memory into long-term memory is called encoding and the active processing of information that takes place in working memory to facilitate encoding is called rehearsal. Later the learner needs to extract this newly gleaned knowledge from long term memory into working memory to apply it within a real-life context. This is termed retrieval (Clark & Mayer, 2003). Thus the learning trajectory loops a full circle and reaches completion when acquired knowledge is successfully retrieved and applied in multiple contexts. Meaningful learning ensures that well learned content held in long-term memory is easily brought into working memory (Ericsson & Kintsch, 1995). Retrieving and applying schemas stored in long-term memory is crucial to solving high level problems involving complex interactivities, thus highlighting the central role played by long term memory in cognition dynamics.

Figure 2 Human cognitive architecture for information processing[2]
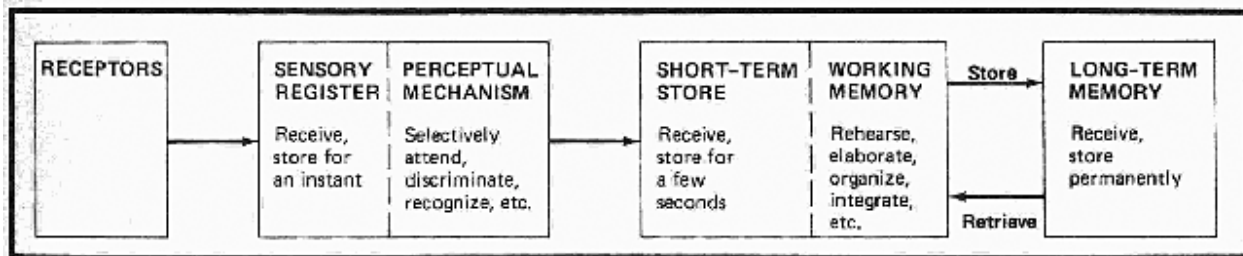


## Theoretical and pedagogical underpinnings

There are several contesting and complementary theories in the cognitive psychology domain that scaffold our understanding of how information is processed to enable active learning to take place in multimedia-enabled learning environments. Cognitive load theory (Sweller, 1988; 1994;1999; Sweller, van Merrienboer & Paas, 1998) sheds light on the interactions between information and cognitive structures and the concomitant ramifications of these interactions on instructions. Cognitive theory of multimedia learning (Mayer, 1997) outlines that learners have dual information processing channels of visual and verbal conduits to guide the educational development pathways. The auditory narration flows into the verbal system whereas animation is directed into the visual system.

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[2]From "Educational Psychology" by Herbert J. Klausmeier, 1985, p 107.

Information processing theory shows how people absorb information in a manner similar to that of computers. However multimedia technology, although capable of delivering huge amounts of information, is severely hampered by the capabilities of the human receptors (Bagui, 1998). Dual-coding theory suggests that humans process separate channels of communication independently and therefore different information must be coded and presented in appropriate media types while cue summation theory posits that the human nervous system acts as a single channel with a limited capacity (Severin, 1967 cited in Donovick, 2001). My discourse analysis is a synthesis culled from the abovementioned theories and auxiliary principles.

**Discourse 1**
**Multimedia Principle**

The first principle is to make use of two modes of representation rather than one in explaining a concept (Mayer & Moreno, 1997). This is termed the principle of multimedia as it seeks to code knowledge in at least 2 different forms of visual representation to convey meanings in richer and contextually distinct manners. Nomenclature for this axiom varies although its application remains the same. Mayer and Moreno (1997) label this principle as multiple representation principle while Clark and Mayer (2003) call it multimedia principle. This precept advocates the use of words and pictures rather than words alone. Such a strategy facilitates learners to mentally build two schemas of understanding in the shape of a verbal model and a visual model and then construct connectivity and interactivity between the two to be able to integrate the new piece of information with the existing knowledge base (Mayer and Moreno, 1997). However, a collage consisting of just any pictures and words will not affect active and engaging learning. What would be needed is a coherent and meaningful combination of appropriate text and pictures to coordinate information processing activities and cognitively improve users' learning abilities (Clark & Mayer, 2003).

**Discourse 2**
**Split-Attention Principle**

The second principle is that when text and graphics are presented, they should be integrated and presented with corresponding words and pictures contiguously rather than separately. Mayer and Moreno (1997) label this as contiguity principle. Others call it split-attention effect as attention is diffused when text and pictures are placed one after the other rather than contiguously (Sweller, 2002; Chandler & Sweller, 1991). Split-attention principle could be enforced by placing printed words next to the corresponding pictures to convey relevant meanings or through the activation of pop-up message boxes to enable users to roll over the mouse on the graphics and read further explanations and descriptions (Clark & Mayer, 2003). This is consistent with the understanding that working memory is limited in its cognitive resources and so as not to overtax these precious resources by looking separately at disjointed text and pictures, they instead must be situated contiguously for the viewers to construct a coherent structure by visually drawing inferential connections between them.

**Discourse 3**
**Multimodality principle**

In designing multimedia content, words should be presented as auditory narration rather than visual online text only. This is called multimodality principle as it incorporates at least two different media of representation to scaffold and streamline information processing in learners. This is predicated on the understanding that our working memory consists of at least two information processing conduits as visual and auditory channels. Using visual text and pictures alone could overburden the cognitive capacities of the visual channel since both the screen text and graphics would be competing for the scarce resources of the visual channel (Clark & Mayer, 2003; Sweller, 2002). Using dual mode instead of a single mode for information processing enhances the performance of working memory as the processing workload is now distributed across both channels (Penney, 1989).

**Discourse 4**
**Redundancy Principle**

This refers to situations where there is an overlap or replication of meaning and information between what the textual and pictorial representations are trying to convey (Clark & Mayer, 2003). Thus some of these materials become extraneous. What might have been intended by the multimedia developer

to be an enabler or at best an innocuous embellishment could instead turn out to be a counterproductive learning interference and distraction that results in learning decrement. This is due to the fact that the visual pathway could be stuffed heavily with materials to be cognitively processed when in fact both the text and pictures are merely duplicating what they wish to convey in terms of information and understanding (Sweller, 2002).

**Discourse 5**
**Element interactivity principle**

The effects of multimedia, split-attention, multimodality and redundancy are referents invoked when the learning materials are of low element interactivity i.e. score low in terms of cognitive complexity. On the other hand, learning content of high element interactivity is bound by the implications of the aforestated principles. Thus for the development of high complexity resources the multimedia designer has to bear in mind the impositions of these principles to avoid taxing the limited working memory assets (Chandler & Sweller, 1996; Ford, Chandler and Sweller, 1997).

**Discourse 6**
**Individual Differences Principle**

The abovementioned principles of multimedia, split-effect, multimodality and redundancy are more applicable for low-knowledge than high-knowledge learners, and for high-spatial rather than low-spatial learners (Mayer & Moreno, 1997). These distinctions arise since high knowledge learners, due to the well-grounded mental schemas they hold internally, are less needful of the effects of multimedia and contiguity. The relevance of these effects becomes accentuated in their application in multimedia learning environments involving low knowledge users (Mayer & Gallini, 1991) who need meaningful scaffolding to guide them in their learning curves. Learners who have high spatial ability hold onto visual images in the visual component of the working memory for longer periods of time therefore contiguity and multimedia have more benefits for high spatial learners (Mayer & Sims, 1994).

**Conclusion**

This article seeks to inform multimedia and instructional designers of the guidelines they could refer to in creating effective and engaging multimedia resources to scaffold and anchor purposeful and active learning. These guidelines gleaned from cognitive psychology literature are a useful source of knowledge that consider the interplay and interaction of an array of factors which, when appropriately incorporated, would augment existing instructional design strategies to produce illuminating and meaningful multimedia materials. Such rich multimedia resources invariably empower learners with improved educational competencies and enhance their learning trajectories. Indiscriminate use of multimedia effects in e-learning courseware alone however would not guarantee learning increments for users. Rather, a judicious approach based upon a mix of sound cognitive psychology and instructional design principles would enable the users in active electronic learning environments to yield authentic learning outcomes.

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