EFFICACY OF MULTIMEDIA AND ANIMATION AS A TEACHING TOOL

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ABSTRACT

The tremendous potential of Multimedia and Animation as an aid to the learning process is not a new concept though the application and refinement of it is a continuous ongoing one. Even as newer and more sophisticated tools and software enter the open market, mostly to serve the burgeoning needs of the entertainment industry, the application of this visually exciting and invigorating tool as method to make the learning curve less steep should not be ignored. In this paper we examine the usage, as well as the degree of success that animation has achieved in simplifying complex concepts, strengthening long term memory retention, why is animation more effective than other teaching pedagogies, and the growth of e-learning as an alternative learning strategy to address the growing necessity of a rapid and effective teaching methodology.

Keywords: Animation, Multimedia, Interactivity, e-learning, Simulation, Rich Media

Introduction

Before we delve into the efficacy of Multimedia and rich media applications as a learning tool, it is important that we possess an operational definition of Multimedia. The definitions are so many and varied that it is really difficult to find one single definition that encompasses all it's variegated aspects. One popular student textbook on multimedia begins with this description

"Multimedia is an eerie wail as two cat's eyes appear on a dark screen. It's the red rose that dissolves into a little girl's face when you press "Valentine's Day" on your iPhone. It's a small window of video laid onto a map of India, showing an old man recalling his dusty

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journey to meet a rajah there. It's an e-catalog of hybrid cars with a guide to help you buy one. It's a real-time video conference with colleagues in Paris, London, and Hong Kong, using whiteboards, microphones, and question techniques on your office computer"[i].

While this picturesque explanation of multimedia is more visual and descriptive rather than informational, it does provide a rather lyrical depiction of what the layman understands by multimedia. A more precise definition is provided by authors Richard E. Mayer and Roxana Moreno who define multimedia thus:

"Multimedia can be defined in terms of sensory modalities (e.g., visual vs. auditory), representational modes (e.g., pictorial vs. verbal), or delivery media (e.g., screens vs. speakers)"[ii].

A more general and working definition of multimedia would be that it is any combination of text, art, sound, animation, and video delivered to you on a computer or other electronic or digitally manipulated means. Since it is a richly presented sensation, the term "rich media" is also very often used to describe a multimedia presentation or experience.

An area of confusion that often occurs is when the terms Multimedia and Animation are used interchangeably, when in fact that are separate entities and executed very often independently with software that are specifically designed for that purpose. Although the visual experience and impact is very often similar, perhaps the most distinguishing difference between the two is that Multimedia in a great number of cases carries the added advantage of 'Interactivity' whereas 'Animation' is very often a linear executed sequence of images or sounds as a one time occurrence (unless the player or output device is rewound and the animation once again played out).

Animation can very well be defined as "the process of generating a series of frames containing an object or objects so that each frame appears as an alteration of the previous frame in order to show motion" (Baek and Layne, 1988). Another definition of computer animation is:

"Any application which generates a series of frames, so that each frame appears as an

alteration of the previous one, and where the sequence of frames is determined either by the designer or the user".[iii]

Animation and multimedia

Regardless of nomenclature and definition of terms, in actual practice, animation and multimedia are significantly different. As mentioned before, Multimedia usually, though not necessarily always, implies a high degree of user interactivity, enabling the user to pause, fast forward or rewind any particular phase of the presentation. This element may or may not be present in an animation. In most animations for the corporate or the broadcast television world, the animation plays through and there is no opportunity to rewind or slow down or pause the animation. Secondly, as most multimedia presentations are derivatives from a web design interface or a presentation which will ultimately be uploaded on the Internet, bandwidth is an important consideration and hence most multimedia presentation use some sort of compressions (achieved through the use of 'Codecs'[iv]) which considerably limit the size of the presentation or the web site so that information can be displayed rapidly with minimal delays in uploading of content.

Although definitions do help in operationalizing concepts and laying a theoretical foundation for the constructs that we will be developing, both the creation, usage and application of multimedia and animation significantly differ. In this paper, however, rather than attempting to explore the differences and areas of usage of the two audio-visual medium, we will examine which if either or both are indeed effective in enhancing cognitive learning and memory retention and how they compare with traditional methods of imbibing instructor imparted education. It is generally agreed upon by most academics and scholars that animation being a dynamic process in preeminently suited for the illustration of difficult-to-grasp concepts and explanation of dynamic phenomena that involve changes over time like mechanical, biological, or meteorological systems[v].

For those in the educational field, multimedia has three very relevant characteristics. Firstly, multimedia means multiple media; the power to choose the kind of information that best conveys a particular concept. Second, multimedia means information access, which makes immediately available large amounts of information. Finally, multimedia means interactivity,

which empowers both the developer and the user of multimedia applications as they create, manipulate, and access information. (See figure 1)

Many theories have been propounded and still more are being developed, which explain through various psychological processes, the manner in which multimedia presents information to the brain and how it is absorbed and assimilated.

Mental model theories such as the 'dynamic mental model' propounded by Narayanan and Hegarty (2002) and the selection, organisation and integration model (Mayer 2001, 2005), wherein spatio-temporal relations in the mental model can be directly mapped to spatio-temporal, thereby leading to a reduction in cognitive processes load would lead us to believe that animation indeed aids comprehension, but research on the impact of animation on learning outcomes, has proved otherwise. Most studies found little if no benefit from animated graphics over static ones on learning outcomes (Tversky et al., 2002). Several studies, designed in agreement with principles derived from multimedia learning theories, suggest that animated graphics may not improve learning compared to their static equivalents (e.g., Catrambone and Seay 2002; Hegarty et al. 2003; Lowe 2003)[vi].

Another factor which also interferes with the learning process is what is known as the *inhibiting effect* (Schnotz and Rasch, 2008). Their contention is that as changes over time is directly perceived from animation and does not have to be inferred, the use of animated pictures can inhibit the learners from mentally animating the dynamic phenomenon, leading to a shallow process of information. Another drawback is that as animation involves change over time, information is transient and cannot be reinspected, contrary to a series of static pictures (Tversky et al. 2002). Furthermore, animation also places a further strain on the memory as each and every change needs to be memorized (initial point, type of change, etc.).

Although there are several criticisms of animation or multimedia as an effective teaching tool, the general body of opinion is in support of the use of animation or audio-visual aids in the enhancement of learning. According to Schnotz and Rasch (2008), there are three possible effects of animated pictures on the learner. One they call is the *facilitating effect* wherein a dynamic mental model or picture can be easily constructed since the existing animation precludes the necessity of creating a demanding mental simulation. The other is the *enabling effect*, which basically means that the simulation or animation conveys the microsteps or fills

in the gap between larger steps that take place when a learner tries to understand a complex phenomena. The third effect is the inhibiting effect which means that as all changes over time can be directly perceived, the animation inhibits or prevents the learner from using cognitive mental processes to construct a complete mental picture, and hence he is not using all of his faculties in the learning process, there is only a shallow processing of information.[vii]

Other authors and research scholars are enthusiastically in favour of multimedia especially as an enriched learning exercise. The use of multimedia in education and training is proliferating because it delivers a new level of "learning" and "seeing" (Ragsdale and Kassam, 1994) or what Lambrecht (1993) calls cognitive enhancement. Multimedia is particularly rich because it presents diverse modalities and presents them simultaneously.

Why is Multimedia so much more effective than other teaching methods? Apart from the reasons cited above, there are three main principles, known as 'Multimedia Principles' which attempt to explain this phenomena.

The *first* principle is that students learn more deeply from animation and narration than from narration alone. The theoretical rationale for this principle is that students are better able to build mental connections between corresponding words and pictures when both are presented. The *second* principle is that students learn more deeply when on-screen text is presented next to the portion of the animation that it describes than when on-screen text is presented far from the corresponding action in the animation. And the *third* principle is that students learn more deeply when corresponding portions of the narration and animation are presented at the same time than when they are separated in time. (see Figure 2)

Through aural information, the learner selects some of the words for further processing in the verbal channel, organizes the words into a cause-and effect chain, and integrates it with the visual material and prior knowledge. Animation enters via the eyes, so the learner selects some of the images for further processing in the visual channel, organizes the images into a cause-and-effect chain, and integrates it with the verbal material and prior knowledge.

Many see it as a revolutionary learning tool with new applications (commonly termed as 'apps') being developed almost every day. As one author puts it:

"As developers and users gain experience with multimedia tools, however, new applications are likely more fully to exploit the specific strengths of multimedia with increasingly dramatic effects. There are, in fact, already indications of a sort of evolutionary ladder of multimedia applications for higher education. Examining its various rungs is one way to explore the uses and potential of multimedia".[viii]

We have already mentioned that one of the greatest strengths of Multimedia (as distinct from a stand alone animation) is Interactivity. That is user defined input and user controlled input. Some of the other benefits of multimedia as distinct from traditional forms of education and imbibed learning are:

(i) Content is continuously upgradable.

(ii) Content can be modified by user according to his or her convenience and requirements.

(iii) Visually and aurally stimulating and motivating.

Through the addition of images and/or sound, the presenter can make important points more apparent (Trainor and Krasnewich, 1994) and graphics and visual cues complement texts. similarly sound complements text with voice-overs and other aural effects to create a mood, add emphasis and communicate ideas (Asstmetrix Press, 1994). Research shows that audio visual material aids information recall and makes a greater impact on the learner than either lecture or written matter alone (Athapilly, Durben, and Woods,1994; Fletcher, 1990; Trainor et al., 1994)

Practical applications of multimedia

Multimedia imparted instruction finds premier applications in not only the academic sector, but in many other industries as well. It is extensively used, and it's efficacy has long been recognised in the medical industry. Medical students are exposed to the inner workings of vital organs like the heart and the brain through visual simulations and complex three dimensional modeling and animation. Processes like the circulation of blood and the Digestive Cycle, bodily functions of which knowledge exists yet which is hard to visualize is explained and demonstrated through animations and multimedia. This kind of instruction can be imparted either through offline content in the form of a CD/DVD or a program which can be installed on a computer or in the form of web based learning or e-learning which again can be either online or offline. Particularly in the medical field, experiments can not always be

conducted on rats or rabbits. Neither can human anatomy and physiology be learnt or understood by dissections on these lesser animals. While it is true that dissections and vivisections can lead to a greater understanding of anatomy, this can only provide an explanation of parts of the body, not of processes. Whenever a process or a cycle needs to be understood, animation proves to be an invaluable tool in aiding comprehension. The problem in medical education is that the subjects necessary to "deliberately practice on" are human beings with all their diversity and variability. Furthermore, changes in medical practice that have reduced physician teaching time and decreased the availability of patients as educational resources and the rapidly increasing options for disease diagnosis and management have created a need for new methods of instruction, knowledge acquisition, and assessment[ix].

Studies conducted in the effectiveness of e-learning as against traditional learning has shown significant results in costs and also greatly increased convenience as content can be delivered to the user's computer which s/he can peruse and study according to their time and pace.
E-learning can result in significant cost savings, sometimes as much as 50%, compared with traditional instructor-led learning[x]. Studies in both the medical and nonmedical literature have consistently demonstrated that students are very satisfied with e-learning[xi]. The Federal Interagency Working Group on Information Technology Research and Development has recommended the establishment of centers to explore "new delivery modes for educating medical practitioners and providing continuing medical education"; e-learning clearly fits that description[xii].

Another area where Multimedia and high end three dimensional graphics and animation has proved absolutely indispensable is in the training of defense staff. For officers in the Air Force, extensive flight simulation lessons are conducted which is mandatory to be completed before they embark on actual hands on training on real aircraft and engage in actual combat simulations. This particular kind of training requires the use of extremely high end software and hardware and complex algorithms which can keep pace with the demands of a visual environment which is changing almost every second. The 3D environment has to be not only realistic, but also screen redraws and refresh times have to be extraordinarily fast, a term which in computer jargon is referred to as 'real time display'. Since 1985, flight simulation had a major impact in military flight training. It is arguable that flight simulation was introduced too early into military flight training, giving rise to the view that military flight

training was more effective in an aircraft. This argument was further reinforced by the lack of fidelity of flight trainers in the 1960s, giving simulation a bad reputation in many military organizations.

As the cost of training came under strict scrutiny and environmental issues became more prominent, military organizations reviewed the benefits that had been achieved by civil flight training organizations and simulation became an integral part of flying training programmes throughout the world[xiii].

Today, the use of flight simulation in both civil aviation and military training is commonplace and widely accepted (Allerton, 2000). These simulators allow flight crews to practice potentially life-threatening maneuvers in the relative comfort of a training centre. Similarly, military pilots are able to rehearse complex missions and to practise piloting skills that may be unacceptable in environmental terms (in peace time) or prohibitively expensive, for example, the release of expensive weapons[xiv].

Multimedia in the workplace

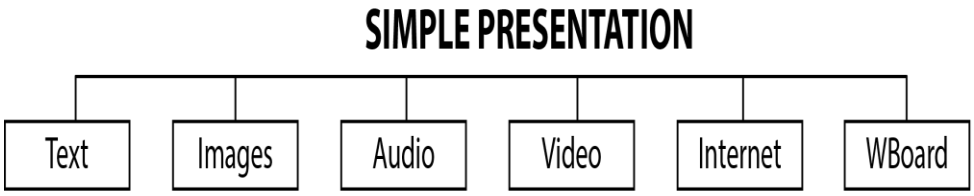
Multimedia explication adds power for presenters of information in virtually every field of study not only because it provides new tools but also because it leads us to consider information more broadly and to look both across media and, very likely, across disciplines for new sources of insight[xv]. But how does this translate itself into workplace culture? Almost everyone has at some stage used Power Point, a Microsoft software package which today has become an indispensable tool for effective presentations, both in academia as well as in corporate communications. Although as its name suggests, Power Point is indeed a powerful software, it only serves as an entry point for more complex presentations featuring rich media. Packages such as Adobe Flash and Adobe Raptivity are used extensively for advanced e-learning self paced tutorials which are SCORM compliant and incorporates a high level of interactivity and user input. These software use the combined impact of rich stereo dolby sound, high end two dimensional and three dimensional graphics as well as PDF files which can be viewed on screen or downloaded for later (offline) viewing to create a complete and visually invigorating learning experience. Moreover software such as the ones mentioned above as well as many others, are constantly being updated so as to include new tools and newer faster methods of creating customized animation which can illustrate complex, hard-

to-grasp concepts.

Conclusion

It is fairly evident from all these arguments and views that multimedia is indeed an invaluable learning tool. It is particularly important in a learning environment where access to a real world situation or simulation is either impossible or extremely difficult to visualize and/or conceptualize. As we have seen, the topic is not free of controversy. There are some situations where multimedia and animation has proved extremely useful and contributory; in other situations it has only had a mild impact. But it is evident that as software and hardware both take quantum leaps in terms of technology and visual impact (the powerful and visually stimulating animations that we see in movies and on television advertisements are sufficient proof of this), application of this learning method will only see an increase in the coming years.

In present years e-learning and self paced user instruction has greatly increased as students and new young employees feel pressured to compete in the market by increasing their qualifications, and all e-learning has a sizeable multimedia component to enhance learning efficacy. Whether this is only a passing trend, with students resorting to time tested learning methods such as books in the long run, is a debate which cannot be easily resolved by any one study in any one environment, no matter how rigorous. But one truth is self evident. Tools and techniques of animation are only growing; becoming more and more refined with every passing year, with skilled manpower to use this medium, also growing. Definitely, we can predict that both multimedia and animation are here to stay and find increasing application in every industry where learning is required.



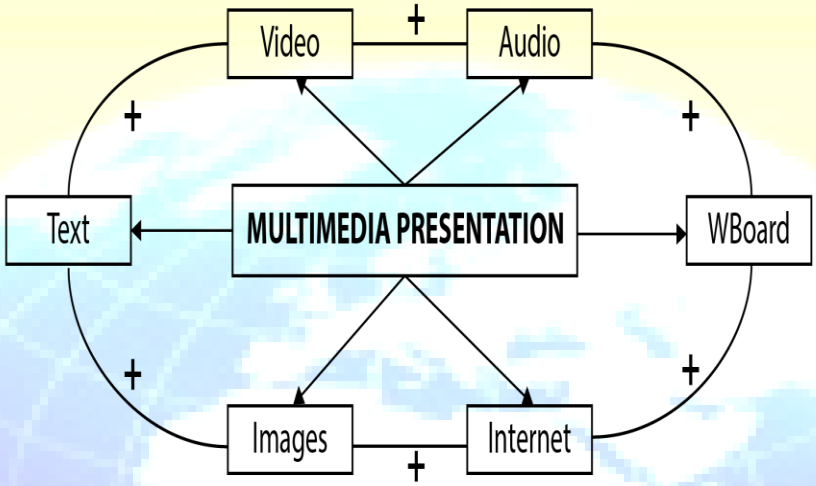


Figure 2: A cognitive theory of multimedia learning

Source: self

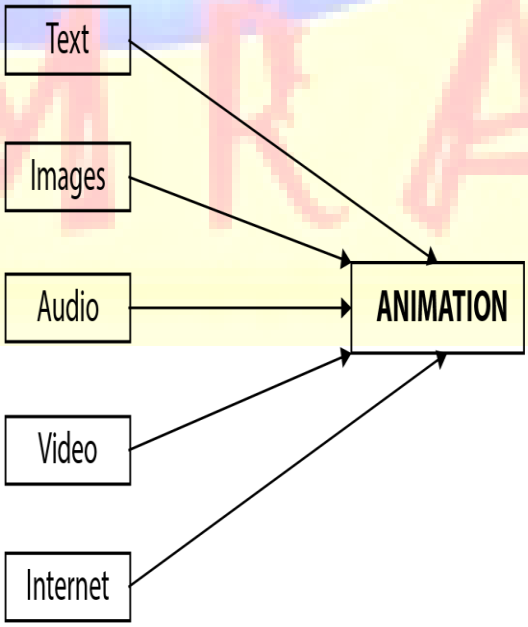
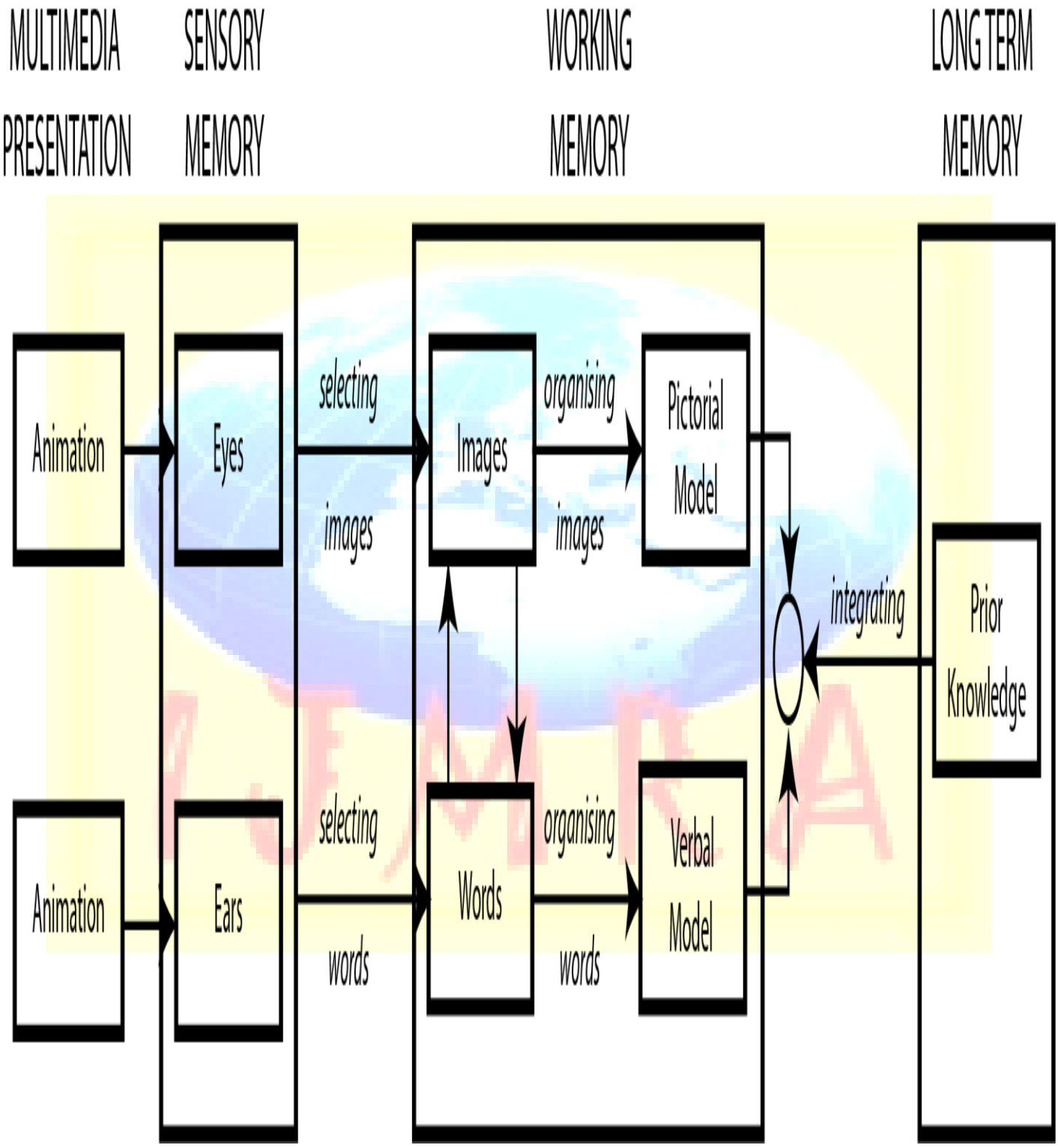


Figure 1

Combination of text, images, internet and audio-video inputs in different types of presentations


MULTIMEDIA PRESENTATION
SENSORY MEMORY
WORKING MEMORY
LONG TERM MEMORY
Animation
Eyes
selecting
images
Images
organising
images
Pictorial Model
integrating
Prior Knowledge
Animation
Ears
selecting
words
Words
organising
words
Verbal Model

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