MULTIMEDIA IN MEDICAL EDUCATION

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Accepted: 21 November 2012

1. INTRODUCTION

The spectacular advancements in the field of medical education in the recent decades have been largely possible because of the application of Multimedia. Multimedia education allows one to proceed at one's own pace. In addition, multimedia has the special capacity of interactivity and it achieves its greatness through its interaction. The word interaction from its Latin origin describes a mutual dealing between two or more people. If we apply the same word to computer, interaction means that program execution depends on the user's input. According to Sansot (1985), interactivity seems to designate “.... Rather an instrumental relationship between humans and machines under control of a request for information”. In this perspective, interactivity is bound to the field of human-to-machine interactions. Multimedia software allows educational developers to orchestrate and direct the combination of text, graphics, and animation, audio and video images into highly interactive program. The user of multimedia is able to decide what information should be narrated by the newscaster and in what sequence. The control of the programme is with the user by pressing a key or clicking a button or touching a screen. The books we read the content we write and the televisions we watch are not in an interactive way. With the inclusion of a keyboard and a mouse, a computer can easily accept user's input. Here, the user is allowed to take control of programme execution. When the user clicks hotspot, it will display another file or in the programme i.e., linked file, which can be a sound file, a digital video clip or image file with new information. In this way, a personal computer is becoming the interactive multimedia machine of today. Modern medical education faces new challenges as the attitude of the health care delivery system transforms. These educational challenges are particularly felt in the teaching of surgery. The Interactive Multimedia utilizes rich media objects and high-resolution videos to overcome modern didactic challenges. It integrates digital video, 3-D models, self-assessment tools and generates a dynamic learning environment encompassing core surgery topics. The interface designed to focus on a narrative timeline that provides students with a familiar metaphor for interacting with the learning objects. In this article, the author mainly highlights the application of Multimedia in teaching and research in the field of medical education, which can lead to a better learning in medical sciences.

2. INTERACTIVE COMPUTER SIMULATION

Simulations include Computer graphics and image reproductive system (Sullivan, 1995). Heim (1993) maintains that the key aspect of simulation is to offer a replica of real environment of object that fools our senses into perceiving the simulation as real. Computer simulations are built from models of real world situation. Because reality is complex, models are built to simplify the reality so that, it can be easier to study its most important features. Learners could never write well about something until they had thought well about it. Simulations are opportunities to work with learners on how to think well about complex matters. Thus, Computer Simulation exemplifies how to promote the learning effectiveness by utilizing various animations and models. Educational Simulations are metaphors designed to focus learners' attention towards concepts, which allow them to explore artificial environment, imaginary or based on reality. The educational simulations also provide a good opportunity for exploration, experimentation and interaction. The learners can experience the consequence of their actions without facing risk. Leon A and Leon M Leon. (1999) maintain that with a simulation, the students are in control of the learning environment. It is up to them to find and use information to draw conclusions. Simulations allow learners to have experiences that would not be possible otherwise. Instead of simply spewing facts, simulations provide a context for knowledge. Thus, these simulation technologies offer an opportunity to bring elements of active practice into the classroom. The interactive simulation software is now being used frequently as a training tool. Fitzgerald (1999) argues that Virtual training using interactive simulation software is effective in teaching mailroom operations. Graphics, Sound and Video are used in Interactive Simulation to create semi realistic 'Microworld' which learners explore in order to solve a relatively ambiguous problem, a process quite different to learning from text books, lectures or videos. One advantage of 'Microworld' is that learners form meaning by lively and selectively working through a range of different information sources, a process, which mimics real-world learning, enhances higher order learning outcomes. The immersive quality of 'Microworld' may be more motivating than other teaching/learning modes at least to some learners. Certainly, the major role for simulation is to provide an opportunity to practice a wide range of higher order skills from collaboration to problem formulation and critical thinking.
3. COMPUTER SIMULATION IN MEDICAL EDUCATION

In medical teaching, if there is no perceptual knowledge-based, students can only be on paper. Multimedia teaching can provide perceptual knowledge and it can be the actual specimens of clinical picture in patients with typical symptoms and signs visually displayed in front of learners and provide a large number of specific clinical information; in the mechanism for teaching complex, difficult, experimental costs are high, rare and difficult to entities in the operation content, are available through the kind of teaching courseware realistic images, three-dimensional animated simulation demonstration, so that learners will soon integrate theory with practice, access to emotional experience.

Appropriate active learning experiences are indispensable in learning Medical Education. Well-designed laboratory experiments provide the best means to learn Medical Education. However, there are many barriers on the use of real laboratory experiments. As a result of these difficulties, computer simulations have created several physiological phenomena that can be used to supplement traditional laboratories and lectures, providing students with many more opportunities to learn by experimentation. The learner can manipulate the size, shape, orientation and dimensions of any diagrammatic illustrations through simulation. This has been supported by many research studies. A few studies have been reviewed here: Madden M, Adarve R. (2011) who describe the anatomical characteristics of adult human dentition through a computer-based learning resource which provides photos of extracted tooth specimens and lists the anatomical details from five specific aspects: mesial, distal, facia, lingual and occlusal (incisal). This resource is a multimedia approach that the learner can use to study the anatomy of human adult dentition. This can be used by students to assist them in learning while faculty can use this as an additional resource to complement teaching dental anatomy. A lab manual that contains drawings of each tooth has proven to be very effective in providing information needed by students to learn the different morphological characteristics of individual teeth. The interactivity in this new learning resource allows students to view the photos of actual tooth in 360 degrees and the ability to enlarge the photos are added features that will make learners experience much more enriching. Another study was conducted by Conrad H, Buchanan J, Welk A. (2010) who used an interactive multimedia learning environment for dental training and practice. The training program combines a virtual and clinical environment to provide a case history, patient, online instructor, visual tracking of the procedure, and real-time feedback and evaluation of the procedures performed. One Hundred first year dental students are using this web-based tutorial every fall semester prior to entering the Advanced Simulation Clinic. It has proven to be effective at decreasing the students’ dependence on faculty when beginning and while advancing through an introductory operative course.

Stein, et al., (2010) developed a multimedia instructional tool for medical students and residents in emergency medicine, dermatology and plastic/cosmetic surgery. This project was designed to provide medical students and residents with options in anesthetizing the faces of their patients. The videos in the multimedia tool walk the user through the proper technique for the injection. This project is really about enhancing patient care. It is significant because it provides an easy to use educational tool that delivers the basics of administering intraoral blocks to obtain facial anesthesia.

Gould D. (2009) used multimedia to simplify study of the structure and function of the brachial plexus. In his programme, he uses a combination of novel illustrations, animations, clinical photographs, explanatory text, and a set of printable questions to provide an easy to understand tutorial for the brachial plexus. Student evaluation of the program highlights its ease of use, clear and intuitive navigation, and validation that the use of illustrations and animations were beneficial to understanding and retention of the material.

Jevtic J, Torre D, Sebastian J. (2007) used an interactive e-module to improve the knowledge and skills of medical students in cardiopulmonary physical exam. The module is accessible via internet using the course management platform. Seventy percent of students rated the web-based module as very good or excellent. Qualitative data indicated that medical students felt the web hyperlinks, cases, graphics, video and audio files enhanced their learning experience. They described ease of accessibility and flexibility as key favorable components of the module.

3.1 Simulation in immunology

For instance, how macromolecules are transported in and out of the nucleus can be taught by simulation. The simulation can be created to be an exercise for learners in an immunology course. Simulations in immunology offer the possibility of performing high-throughput experiments that can predict, or at least suggest, in vivo phenomena. In the simulation the learner, will establish experimental conditions, obtain data via the simulation and use this data to determine the number of sites on an antibody molecule that bind antigen and the strength of binding between the antibody and the antigenic determinant. The learner’s task is to determine the numerical values for these two important immunochemical properties using the Scatchard Equation. Each day a different antibody with different properties can be used in the simulation. The assumptions are made that only one species of antibody is present in the experiment and that all interaction between antigen and antibody is specific. A large number of T cells packed at realistic densities, and includes dynamic cell trafficking that allows the lymph nodes to swell and shrink as the immune response progresses can be explained with the help of simulation model. The simulation model includes the kinetics of cognate T-cell proliferation and release, and the changes in their avidity profile, are similar to those observed in vivo.
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3.2 Simulation in Cell Biology
Molecular exchange between the nucleus and cytoplasm is essential for keeping Eukaryotic cell alive. For example, RNAs are transcribed in the nucleus and then exported into the cytoplasm; whereas all proteins needed in the nucleus are synthesized in the cytoplasm and must then be imported into the nucleus. Nucleo-cytoplasmic transport is not only essential for keeping Eukaryotic cell alive, but it also produce regulation of transcription, DNA-Repetition and the Cell Cycle. The teachers combine structural, functional, bio chemical and genetic approaches to investigate the mechanism by which macromolecules enter and exit the nucleus. This mechanism can be very well taught with the help of simulation.

3.3 Simulation in Microbiology
In a microbiology lab, bacterial culture is an important, expensive and time-consuming task. For instance, when students are working with a real gonorrhea culture, teachers usually must monitor them closely to make sure they do not start the wrong procedure and waste the valuable material. In computer simulation these problems can be easily overcome. Students can run experiments with virtual bacterial cultures by telling a computer what chemicals to add. The reaction times are cut to minutes and letting students spend more time on experimentation.

3.4 Simulation in Clinical Encounter
A wide variety of computerized, clinical encounter simulations has evolved in the last decade. Computers are used to simulate “patients”; physicians or students interact with typewriter-like computer terminals to solve the “patient's” problems. Although the setting does not simulate all aspects of a physician’s interaction with a live patient, the essential feature of information flow between the two is captured well, particularly if efforts are made to make the simulated interaction more “human” and less machine-like (Senior, 1976). A more “human” system is characterized by language that is easily understood, by responses that can be corrected quickly, and by courteous and considerate instructions (Sterling, 1975). Only rudimentary typing skills, and no knowledge of computers or programming, are required of the user. Inquiries either can be directed to the patient by typing in actual questions, as words or as sentences, or as code numbers referring to questions or desired studies. Successful experiments also have used a standard touch-type telephone to communicate with the computer patient (Friedman, et al., 1977). Diagnoses can be entered, management decisions or actions can be initiated, and data may be reviewed.

3.5 Simulation in Medical Lab
The most striking innovation in learning medical sciences is the utilization of Virtual Lab. Virtual Lab allows students to learn by actively designing experiments and interpreting their results. Virtual Lab (VL) is a highly interactive, computer-based multimedia environment in which the user becomes the participant in a computer-generated world. An important key feature of VL is real-time interactivity where the computer is able to detect user inputs and instantaneously modify the virtual world in accordance with user interactions. VL consists of technological hardware including computers, head-mounted displays (HMD), and motion-sensing data gloves. Another important advantage of the VL is to provide support for different types of learners.

The Virtual Medical Lab (VML), allows students to experiment more than they would be able to in a real lab. This gives the student many more opportunities to practice the skills of hypothesis creation; experimental design and data analysis than can happen in the normal lab or lecture setting (Bell, 1999). Because of time and safety constraints, students usually cannot freely experiment with patients. On the other hand, the computer simulations in the Virtual Medical Lab encourage students to do experiment with fun.

The VML removes the time constraints of the traditional lab and the simulations in VML give students the opportunity to revise and to redo their experiments, to learn from their mistakes, to design and interpret experiments, and eliminate the time constraints. The very important use of a simulation is the potential of permitting the student to design and carry out many experiments than would be possible with traditional laboratory.

Simulation is an essential part of surgical education. It helps surgeons to develop and to acquire skills through practice. Although textbooks and videos can demonstrate steps of procedures, their two-dimensional view and the lack of interaction with them make them poor media for training skills. Techniques are learned using animals and Cadavers have many disadvantages. Animals have a different anatomy than human. Cadavers cannot provide the appropriate physiological response. Corpses are expensive and cannot demonstrate the changes resulting from disease. Latest advances in computer technology allow a new class of simulators to be developed: the computer based surgical simulators. The virtual patients developed by simulation can generate realistic human anatomy and physiological responses. With the help of an interactive “Virtual -Corpse” students can learn about human anatomy without actually anatomizing. Virtual - Corpse takes students step-by-step through an anatomization. Along the way, the mouse takes the place of the retractors, stereotactic devices, scalpels, lancets, drill bits, rasps, trocars, dilators and specula, and forceps a student would ordinarily use in the Medical laboratory. Simulation covers the different stages of the anatomization. Then the students take over-clicking on the places where they would normally insert pins, make incisions, and uncover the human's internal organs. Virtual-corpse lets them know if they have chosen the right locations on the screen. Students are able to visualize and interact with dynamic processes in the body. Learning modules such as cardiovascular, gastrointestinal, respiratory, renal, visual, and neuro-physiological systems are available in VML.
The VML lays the foundation for medicine and for an increasing number of interdisciplinary programs, such as biomedicine, medical informatics, and bioengineering. For example, a medical student learns how the kidney filters blood in order to understand kidney failure in diabetic patients. A bioengineer could apply the same knowledge to build an artificial kidney.

VML is an excellent resource for learning. Its great interactive way reinforces what the students already had learned from lectures and the book and it really helps for the better understanding.

The self-regulated, instructor-guided module in VML facilitates effective learning. A major goal of the Virtual Medical Labs is to increase scientific literacy by using interactive multimedia to teach the fundamental concepts of biology, and to share those resources via the Internet. Some of the advantages of VML are as follows:

i. The Virtual Medical Lab strives to make learning biology fun.
ii. It saves students money.
iii. It allows students to review and repeat labs.
iv. It saves time.
v. It allows students to work at home.
vi. It allows students to quiz themselves.
vii. It develops independent learning.
viii. It nurtures self-motivation.
ix. It provides an opportunity for various self-paced practical exercises.
x. It ensures better understanding of biological concepts.
xi. The simulation techniques used in VBL can bring the learner nearer to the real life.
xii. The VML creates interest among the learners.

The Virtual dissections cannot replace hands-on experience. Doctors say that they could not introduce new medicines and vaccines without being able to test their safety on animals first. They say medicines and vaccines used to treat diseases such as polio, smallpox, chicken pox, measles, diabetes, and cancer could not have been created without animal experimentation. In such situations, VML becomes ineffective. Perhaps VML is not as effective as the real thing, but certainly a valuable tool. The VML cannot replace the traditional lab but it can be used to supplement the traditional lab.

4. ADVANTAGES OF COMPUTER SIMULATION
Good Simulation usually involves well-defined visualization of what is happening. These dynamic visual representations can communicate in powerfully and add significant richness to the data. Computer Simulation is a good tool. It allows the learners,

- To manipulate a number of key variables of some phenomenon and observe the result of that manipulation.
- To change some conditions while holding others constant.
- To explore an endless set of possibilities as long as you are interested.
- To defy time by speeding up events that in reality could take months or years.

Some of the other advantages are as follows,
- Abstract concepts can be easily explained with the help of animation and graphics.
- Self-paced learning is possible in this method.
- More information will be gathered in a short time. Thereby, saving energy and time will.
- It gives tremendous convenience, efficiency and flexibility to students.
- Since the students have control of their own learning environment, they are empowered to determine the time, order, and to a lesser degree, the method of learning simulation concepts.
- Simulation can be used as a stand-alone independent-study course or as supplementary material for traditional method of learning.

- Simulation complements traditional classroom lecture presentations in various ways.
- Graphical animations can explain quickly and easily what can not be explained in a whole book.

5. CONCLUSION
Interactive Computer Simulation can be used to develop active and master learning. In this learning situation, there is active participation on the part of the learner as opposed to passive learning, listening to lectures and demonstrations. It offers an opportunity to bring elements of practice into the classroom. It can stimulate the students’ mind and encourage learning through
all sense because multimedia can combine so many media together. Psychologists acknowledge the important of interactive process for knowledge retention. It crosses traditional boundaries of school, work place, and home, and enabling learners to choose their learning materials, in their own time and at their own pace. The limitation of this technology is that the simulated environments will not be a complete substitute for the real thing but on the other hand, they can provide enough complexity, flexibility and unstructuredness to make them worthwhile vehicle for the practice of many activities, which are not permitted by other teaching method.

REFERENCE