

Chapter 1

Introduction

BACKGROUND

Computer aided learning (CAL) is a terminology used for delivering educational experiences electronically. CAL materials may use any combination of teaching techniques including question and answer, simulation, multimedia, didacticism (tending to convey information), or problem solving. CAL environments increasingly are using a combination of interactive multimedia and virtual reality (VR) such as text, audio and video, graphics and images, two and three dimensional animations, and simulations in presenting learning materials. Interactive refers to the way the user engages in these environments to enhance his/her learning process.

EVOLUTION OF CAL

The first use of computers by educational institutions and the introduction of computers in classroom teaching and technical training began in the 1950's (Megarry, 1983). According to Robert (1994), the most pervasive tool to deliver education is the computer. This is probably due to the increasing popular-

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ity of personal computers (Law and Maguire, 1993). In the 1960's and 1970's, more teaching devices (computers) and teaching CAL applications were developed for teaching and job training. As a result, improvements in computer design during the 1960's enabled the integration of text and graphics; a move that encouraged the development of computer based training programs. Such use was, however, limited, as programming was costly, slow and tedious, and the computing relied on a mainframe, or central computer, to do all the work. The release of the first microcomputers during the late 1970's assisted computing in becoming more portable and affordable.

The paradigm shift from textbook learning to CAL started in the 1980's. Ease of use took a quantum leap with the introduction of the Apple Macintosh computer in 1984. Operation of the computer and its programs became more intuitive and user-friendly largely as a result of intense research in the area of human-computer interaction where graphical user interface was introduced (Kinshuk, 1996). The low cost of hardware equipment and educational software motivated the use of CAL in education and training. Today, as affordable personal computers become more powerful, the range of operations that can be reasonably performed has increased rapidly.

ROLE OF NEW TECHNOLOGIES IN CAL

The use of newer technologies in CAL packages i.e. multimedia and virtual reality, allows highly engaging activities such as interactivity and simulation. Interactive multimedia systems for learning came into existence in the early 90's (Robert, 1994). According to Negroponte (1995), multimedia is simply a mixture of data on digital basis. Multimedia systems support the physical and logical coexistence and interactive use of mixed media classes such as print, audio, and video in specific application environments. Cairncross and Mannion (1999) stated that interactive multimedia systems have the potential to create high quality learning environments that actively engage the learner. Additionally, Cairncross (2002) pointed out that the key elements of multiple media, such as user control over delivery of information and interactivity, could be used to enhance the learning process.

Another emerging technology that is being used in CAL is virtual reality (VR). VR systems were first introduced in the learning environment in mid 90's (Macpherson, 1998). The term 'virtual reality' is currently used to describe a range of computer-based systems in which a user can explore hardware or software generated 'micro world' (artificial environments) that allow close resemblance to reality. VR extends the interaction-oriented features of multimedia i.e. modeling objects and their behaviors in virtual environments, integrating position-tracked human-computer interaction devices, and performing numerically intensive computations for real-time navigation.

The prime feature of VR is 'visualization' followed by 'interactivity'. Special VR hardware and software are thus required to allow human-computer interaction to permit input of the user's actions and movement to the computer, and to provide corresponding simulated feedback to the user. An early application of such system was the flight simulator used to train pilots. However, it is in the area of hi-tech computer games that many of the application developments in this field have taken place.

Although VR has been used for educational purposes (Bell and Scott, 1995, Dede *et al.*, 1996, and Kim *et al.*, 2001), the potential of VR is just beginning to be exploited by a few science and engineering educators (Manseur, 2005 and Liarokapis *et al.* 2007). This will be discussed further in Chapter 2.

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