Computer Animation

Su-Ting Yong
Curtin University of Technology, Sarawak Campus, Malaysia

Yun-Huoy Choo
National Technical University College of Malaysia, Malaysia

INTRODUCTION

The use of computer animation in educational software like a computer-based learning (CBL) program is becoming a common practice. Animation is used in a few industries throughout its long history. Animations are used in CBL programs for the following purposes: to present a concept; to create an interactive user interface; for *simulations*; for *virtual learning environments*, and for interactive *avatars*, *humanoids*, and *agents*. Despite these graphical attractions, the usage of animation in CBL programs also has some limitations. Few types of software can be used to create computer animations, and some of the design principles have to be taken into account to create an effective use of animation in a CBL program. Nevertheless, computer animation has great potential in developing CBL programs in the future.

The history of animation shows that human beings had started to think of capturing motion since the beginnings of recorded history. True animation was first demonstrated in 1828 by a Frenchman, Paul Roget, who invented the thaumatrope (James, 1997). Nowadays, computer animation has gained significance in education, entertainment, and business, as well as the advertising industry, as computer hardware and software technology gets more advanced. In the education industry, computer animation is frequently used in CBL programs to convey information and ideas. Animation is defined as a synthetic apparent motion created through artificial means (McCracken & Wolfe, 2004), and computer animation is defined as a technique in which the illusion of movement is created by displaying on a screen or recording on a device a series of individual states in a dynamic scene (Thalmann & Thalmann, 1998). Animation can consist of moving a static object within a scene, or the object may change its appearance as it is moved (Bederson & Boltman, 1998). Simple animation, simulation, virtual reality, and interactive agents are some of the animations that are extensively used in a CBL program. Animations are able to communicate a huge amount of information in a short period of time and are an effective way to draw students' attention. Maya®, Lightwave®, 3D Studio Max®, Softimage®, Cinema 4D®, Poser®, Macromedia Flash®, Adobe Live Motion®, and Toon Boom® are some examples of animation software.

USE OF COMPUTER ANIMATION

Presentation of Concept

Animation is a most ideal way to present a certain theoretical concept or idea. Animation can be used to show osmosis, diffusion, engine movement, or any mathematical algorithm. According to Creaser and Niklasson (2002), computer animations designed to illustrate basic theoretical concepts are intended to support teaching that promotes a deeper understanding of the influence of the underlying fundamental phenomena. Animation can show real objects in slow motion. Animation can enhance understanding by depicting real objects in slow motion, as in a beam of white light passing through a prism and emerging from the other side as separate wavelengths of the spectrum (Doyle, 2001). Animation can be made to show the theory of mechanics of molecular processes, which is otherwise impossible to be observed even in laboratories. One example is the research done by Sanger, Brecheisen, and Hynek (2001), which demonstrates that students who viewed computer animation depicting the molecular processes occurring when perfume particles diffuse in air and water osmosis occurring through a semipermeable membrane developed more accurate conceptions of processes based on the particulate nature and random motion of matter. Therefore, computer animation can illustrate dynamic or visual concepts, which may deepen students' understanding by making abstract concepts visible. For this reason, animation provides an invaluable learning aid in chemistry or biology. Animation is also good at showing continuity in transition or illustrating change over time. Therefore, animation can be used to show how an airplane flies through the air or how a caterpillar turns into a butterfly. All these illustrations produced by animation cannot be achieved through traditional static graphics.

Interactive User Interface

An interactive user interface is one of the distinctive features of animation. Animation offers a richer set of interactions than video (McCracken & Wolfe, 2004). Videos only allow played, forwarded, rewound, or paused action to be done. However, animation offers a variety of interactions with different kinds of controls, manipulation of parameters, and a range of solutions to problems. Feedback would be produced according to the predefined mathematical model. According to Farr and Lawlor-Wright (1998), the CAL3P (computer-aided learning of process-planning principles) software is employing animation to show how a lathe used to carry out a student's specified operations appeared to result in a more effective learning experience. Farr and Lawlor-Wright further add that the CAL3P software allows students to enter their own set of manufacturing instructions, decide if the process is appropriate, and enter the detailed parameters. Users can actively interact with the software by manipulating the different parameters to get the required result by looking at the animation feedback shown by the software. This process develops thinking skills and leads to discovery learning. Besides giving control to the users, interactions are achieved by giving the students opportunities to create the animations on their own. Students can create animations to demonstrate their knowledge of more complex concepts and structures (Doyle, 2001). Teachers should provide an environment and facilities for students to explore the structure of materials or objects in depth. As students become the active creators of their own animations, they will experience self-directed learning.

Simulation

Simulation is another common usage of computer animation in CBL. Computer simulations are software programs that either replicate or mimic real-world phenomena, which if implemented correctly, can help students learn about technological events and processes that may otherwise be unattainable due to cost, feasibility, or safety (Michael, 2001). Simulations, which are created with computer animation, resemble the real environment with preprogrammed problem situations for the student to work with. This simulated learning environment has a profound impact in the way the student learns about complex problems, both in the social and natural sciences (Milrad, 2002). It is as effective as real-life, hands-on laboratory experiences that can enhance the learning achievement levels as well as the problem-solving skills of students. Hence, the educational benefits of computer simulations for learners show great promise (Michael, 2001)
Computer simulations of natural phenomena afford the use of gestures to support perceptions, which, when students work collectively, may change as a consequence of their negotiations and therefore lead to learning (Roth & Lawless, 2001). Recently, Milrad, Spector and Davidsen (as cited in Milard, 2002) have suggested an approach called *model-facilitated learning* (MFL) in combination with instructional design principles. Key aspects of this design framework include the use of modeling tools, construction kits, and system-dynamics simulators to provide multiple representations to help students develop an understanding of problems in situations that involve many interrelated components that are subject to change over time and often involve ill-defined aspects. The main feature of the educational simulation is that it makes use of a model to represent a process, event, or phenomenon, which has some learning significance. The learner is able to interact with this representation, and the simulation provides intrinsic feedback that the learner can interpret as the basis for further interaction (Milrad, 2002).

EcoSIM is a simulation tool built by Milrad (2002) in order to allow his students to run a system-dynamic simulation model of the impact of pH and

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