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ABSTRACT

Computer animation can be effectively incorporated into computer based instruction programs for English as a Foreign Language (EFL) learning environments. Computer animation is defined as computer-generated animated graphics that function as visual aids to instruction. The applications of instructional graphics fall into two categories: (1) affective functions, which are designed to improve a student's attitude toward learning or to increase the incentive of a student to participate in a lesson, and (2) cognitive functions, which are designed to directly enhance the ability of students to learn from instructional materials. According to design method, computer animation may be classified into fixed-path animation, which is pre-programmed or designed by the software developer, and data-driven animation, which is controlled by the constantly changing data based on user input. The most promising areas of using computer animation for EFL include the teaching and learning of beginning English phonetics, action verbs, and certain cultural elements. Developmental considerations include whether or not to use animation, the choice of programming language or an authoring tool, cultural considerations of target users, operating environment, hardware requirements, and what other resources to use. (AEF)

Computer Animation

For EFL Learning Environments

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Computer animation here refers to computer-generated, animated graphics that function as visual aids to instruction. Computer animation was first developed in the mid-sixties as a means for film production. The early films were produced using programming languages or interactive systems accessible only to computer scientists (Thalmann, 1990; p.17). However, in the last few years, with the rapid development in computer applications as well as the rise in popularity of the GUI-based authoring systems, it is now possible for the average classroom teacher to create some form of computer animation to be used in his presentation or student practice after just a few hours of training.

The equipment is available and so is the technology. As Kini (1994) observed, "Given that the computer is now a relatively common delivery platform for instruction, the opportunity exists to develop a wide range of visually rich learning environments, such as animated illustrations as well as interactive simulations" (p. 7). For educators who are vigorously seeking new and creative uses of computer animation in both instruction and practice, the sky is the limit. Virtually every field of study is filled with opportunities for potential productive use of computer animation.

One such field is the EFL (English as a Foreign Language) learning and performance environment. Traditionally, students learning English in non-native environments had to depend only on texts and audio materials (cassette tapes, records, etc.) for learning and practice. The use of film and video in EFL situations was a giant step forward. However, the sequential nature of these media plus the lack of interaction leaves EFL teachers and learners alike much to be desired.

Our sense of vision represents our richest source of information of the world (Sekuler & Blake, 1985). The visualization quest has found the perfect canvas for painting daring wishes on the computer screen and made long cherished dreams come true. As Rieber (1994) notes, computer learning environments pose particularly exciting and demanding situations for visual communication, and that the range and diversity of visualization that computers offer are unprecedented (p. 8). And lying at the core of the great diversity of visualization computers can offer, is the immense attraction and infinite potential of computer animation. To future EFL

learners, all that may be said and the dynamics of the English-speaking world will be just a mouse click away.

Classification of animation

As is the case of almost every field of research, studies of the past few years, as summarized by Rieber (1994, p. 154), have already generated quite a few colorful and often self-explaining terms, though no less confusing, such as animated visuals, animated graphics, cosmetic and motivational graphics, data-driven animation, real-time animation, fixed-path animation, command-driven animation, and interactive dynamics.

Before exploring possible effective ways to incorporate computer animation into CBI programs for EFL learning environments, it is necessary to find out what computer animation is, what variety of functions it may play, and how it is created. To answer these practical questions, this section will discuss the classification of animation by focusing on three aspects:

- Definition of computer animation.
- Classification by function.
- Classification by design.

Definition of computer animation

EFL teachers interested in creating or adopting animation into CBI programs are often troubled by not knowing what animation is. According to Rieber (1994), animation is "an illusion that tricks a person into seeing something that really is not there" (p.78). He further states that the trick to inducing the perception of a "moving" object on the computer screen involves creating a series of carefully timed, "draw, erase, move, draw" sequences (p.78). Thalmann (1990) also notes that animation "refers to the process of dynamically generating a series of frames of a set of objects, in which each frame is an alteration of the previous frame" (p.3).

Animation, as described above, primarily involves the perception of motion on the screen. Such motion may be represented by that of a "moving" object, or a growing or shrinking geometric shape.

Motion, no doubt, constitutes the very essence of computer animation. By the broadest sense of the word, anything non-static, involving either physical changes (in position, shape, size,...) or status changes (such as color, lightness, font, ...) over time, may be regarded as a form of animation. The frequent and common applications of techniques such as flashing, color change, high-lighting or deeming, and changing fonts of texts in many of today's CBI programs are all evidences of the rich and diverse use of today's computer animation technology. With the help of the many high-level authoring systems, the door to sophisticated animation creation and usage have been pushed wide open to ordinary EFL classroom teachers.

Classification by function

Since computer animation falls under the general category of graphics, and the issues concerning the application of animated visuals in education are quite similar to those of the static visuals (Kini, 1994, p.8), an understanding of the functional classification of computer animation should begin with a brief review of the functional categories of graphics. Alesandrini (1984) classified graphics into three types: representational, analogical, and arbitrary.

Representational graphics share a physical resemblance with the object they are supposed to represent. Analogical graphics show something else and imply a similarity. Arbitrary graphics share no

physical similarity with the things they represent, but illustrate logical or conceptual relationships using a variety of visual and spatial means (Rieber, 1994, p.26).

Rieber (1994) identified five applications of instructional graphics: cosmetic, motivation, attention-gaining, presentation, and practice. These applications fall into two categories of functions, affective and cognitive.

Affective functions

Cosmetic and motivational graphics, classified as the *affective functions* of graphics, are designed to "improve a student's attitude toward learning or to increase the incentive of student to participate in the lesson" (Rieber, 1994, p.46). They serve to add to the "polish or decoration of a package to make a program more attractive or aesthetically pleasing" (Levin, Anglin, & Carney, 1987) so as to raise the general motivational level of a lesson. As Weinstock (1986) stated, "making software 'friendlier'... is the promise of computer graphics in many fields. Picture — especially moving picture — can be the sugar coating that makes information enjoyable, interesting, and better retained" (p. 247).

Cognitive functions

The other three types of graphics serve cognitive functions, and are designed to directly enhance the ability of students to learn from instructional materials. As learner attention plays such a vital role in making the difference between success and failure of any instructional event, "attention-gaining is an important initial event of instruction" (Gagne, Briggs & Wager, 1985), and animation can be an effective way of arousing and maintaining a learner's attention during CBI. Presentation graphics are those that are used to teach, to present information, or to illustrate procedures (Rieber, 1994). Graphics (static or animated) used in practice activities function as visual prompts, feedback, or navigational devices.

Classification by design method

As far as production is concerned, computer animation may be grouped in two different ways. By the production approach, computer animation is either command-based or GUI-based (graphic user interface). However, by the design method, computer animation may be grouped into fixed-path animation and data-driven animation.

Fixed-path animation

Fixed-path animation may be either command-based or GUI-based. Rieber's (1994) description of the key features of this type of animation are "the same exact animation is supposed to happen the same way, in the same place, at the same time, each and every time the sequence is executed" (p.77). This type of animation is pre-programmed or designed by the software developer, and is incorporated into the CBI package before any user ever touches the program. Each instance of fixed-path animation is activated at a specific point of the program. It may be executed automatically or by the user Each time an animation is activated, the user always sees exactly the same thing displayed on the screen. Most, if not all, of the animation created using authoring systems belong to this type.

Data-driven animation

Data-driven animation, the animation of objects based on constantly changing program values such as student input (Rieber, 1994, p 16), may also be either command-based or GUI-based Since this type of animation is controlled

by the constantly changing data resulted from calculations based on user input, it allows the user to alter the paths, the sequences, and the direction of movement of the animated objects by simply modifying the input data.

To incorporate data-driven animation into CBI programs, software developers are responsible for deciding which objects on the screen should be animated and under what conditions such animation should occur and how many variables should affect the animation process. However, once the user takes over, animation occurs when the controlling variables obtain the needed value. Which object is animated and how it is animated depends totally on the values of the variables at the time. The designer of the package has no control over either the sequence or the scope of the animation.

Unlike fixed-path animation which is characterized by repetitions of the same sequence, data-driven animation allows virtually an infinite number of variations for each animation process. And, because of the instantaneous and interactive features of data-driven animation, we may assume that it would produce better results in self-paced performance oriented presentation packages as well as in all sorts of practice centered CBI programs. Of course, such assumptions should always be tested through well-designed and properly administered future studies before anything can be said with certainty.

In the context of computer animation production, two other terms are also used very frequently: frame-by-frame and real-time animation.

Frame-by-frame animation is regarded as "the oldest form of animation" and represents, in fact, the most important fundamental principles underlying all types of animation. Rieber (1994) defined the technique as "when a set of successive frames is constructed so that when shown in rapid succession at just the right rate, one or more objects appear to move." Each of these frames is exactly the same as the previous one except the object or part of an object being animated (p.83). If these frames are displayed at a rate of just around ten frames per second, the animation process appears jerky, as seen in most animated cartoons. However, if the rate reaches 30 frames per second, animation achieves the quality of standard video display as seen in full-motion pictures.

Real-time animation occurs when the computer is able to display graphic frames in a quick enough succession to produce the illusion of motion (Rieber, 1994, p. 13). Motion in this context means full motion as seen in motion pictures or in real life. Truly motion-picture-like real-time animation requires an enormous amount of data storage space and high speed through-put (data transfer) rate. It will probably take quite some time before animation can truly be generated and displayed in real-time in practical classroom use. The term "real-time animation" nowadays is usually used to refer to the type of computer-generated animated graphics found in various simulations, video games, and the increasingly popular virtual reality packages.

Computer animation for EFL

Language teaching has been one of the earliest in educational settings to use micro-computers. However, surprisingly, looking for existing literature on the effects of computer animation in EFL situations was a disappointing experience. No reports were found of any previous studies done in this area, and it does not take too much research to find out why. In the majority of developing nations where EFL

programs primarily exist, computer access for scholarly research is still a luxury, while general use of computers for instructional processes and by the learners are yet to be desired. Few instructional designers are equipped with both EFL experience and adequate computer skills to tackle the problem.

Despite the rather mixed and inconsistent results from studies done in the past ten years (Rieber, 1994, pp. 154-5), it is generally believed that computer animation, when appropriately employed, enhances learning. We know from Dale's Cone of Experience (Dale, 1969) that verbal symbols are among the most abstract forms of learning and are by far the farthest removed from reality. Appropriate use of animation would help create not only an added sense of reality, but also a higher level of learner participation and interaction.

Even though the lack of empirical support allows no exclusive generalizations, the authors experience with and familiarity in EFL procedures tends to suggest that the use of computer animation in EFL programs has great potential for success. Given the label-learning and fact-learning (Gagne, Briggs, & Wager, 1992) nature of much of EFL processes, computer animation is an ideal way of providing the visual system needed for facilitating learning as described by the dual coding theory.

A number of EFL processes appear to stand out as possible areas for producing positive results in the use of computer animation. When judged by the need for external visualization test and learning of the content depending on understanding motion or direction of motion (Rieber, 1994) criteria, the most promising areas may include the teaching and learning of beginning English phonetics, action verbs, and certain cultural elements.

Beginning phonetics

Learning English phonetics in non-native environments is often regarded as an abominable task. Learning to accurately distinguish and reproduce a set of foreign sounds requires, first, a thorough understanding of the mechanisms of articulating those sounds, a knowledge not needed for first language acquisition and is thus generally new to all learners. Second, in an attempt to explain to the learner what actually happens and how to do it, EFL teachers usually resort to highly specialized linguistic terms plus complicated phonological rules, which, more often than not, only add more complexity and difficulty to the job. The task is further complicated by the need to detect the seemingly indistinguishable similarities and the subtle differences between sounds in the learner's native language and those of English, for by the time the great majority of EFL learners start learning English they are already fluent speakers of their native languages.

To a large extent, the general inaccuracy of pronunciation commonly found in EFL learners speaking English results from the "blind" training (lack of means for visualize the articulation process) during the initial sound stage of EFL learning

For learning this new set of sounds, behavioral theories traditionally require repeated mechanical listening and imitating so as to form a new habit of articulation. However, with the cognitive learning theories emphasizing learner understanding of the process, more and more EFL teachers and researchers feel that only audio materials and printed phonetic symbols are far from enough, and that vis-

ual aids for showing the mechanisms of English articulation are clearly needed.

The wide-spread use of static posters, video programs, and flash cards of articulation diagrams are evidence of such needs. Helpful as they have been all along, these traditional means fall short of the expectations in one way or another. Static posters and the flash cards fail to reveal the dynamic features of the sound-making process, while the analog video animation can be very expensive to produce and yet quite cumbersome to use. For quick and inexpensive production of instructional packages that show motion as well as the dynamic coordination of different speech-making organs during the process, while allowing maximum flexibility and ease of use, computer animation is clearly the best choice to date.

With knowledge of English phonetics, experience in instructional design and software development, and skills of computer programming, animation could be created to show the position of articulation, the speech organs involved, the dynamic procedures for correctly producing each and every individual sound in English. Ideally, such a package should include most or all of the following features:

1. Displays articulation position.
2. Highlights articulators involved.
3. Visualizes the direction of movements.
4. Separates the steps of movements.
5. Allows low/normal speed adjustment.
6. Shows sound changes in sequences.
7. Provides synchronized voicing.
8. Facilitates interactive practice.

Being digital, computer animation programs provide almost instantaneous access to any desired portion of the whole package at the click of a mouse. Especially with the proposed on/off synchronized voice features, possibilities for self-paced practice or post-tests are virtually limitless. And, best of all, both teachers and students will be rid of the burden of talking and hearing about phonological rules and articulation mechanisms even before saying the sounds correctly in English.

Words of motion

Words of motion here refer to the large number of English vocabulary items that denote movements, change of status. or performance of a doer (usually a human subject). Especially in the case of learning the differences between or among synonyms, the use of computer animation may prove to be very helpful. Examine the following words:

devour nibble munch crunch
sip quaff gulp bolt gobble
swill pull drag
scratch rub scuff scrape
stroll roam ramble
collapse fall apart
eruption explosion
flip flop
glide slide creep sneak slip

Of course, the list can go on and on. The point is: for EFL learners, those subtle differences between synonymous term are among the hardest to learn. For demonstration purposes, some of the easily-confused items are listed side by side for comparison. At the mere mentioning of each of these words, native speakers can quickly come up with a number of ways or examples of its usage. But the average EFL learners do not have the same background. They need to compare and contrast with other similar terms to pin down what a particular item means and where to use it.

Suppose the learner encounters the word "gobble" in reading, and the con-

texts suggest that it means a way of eating something, but he wants to find out its exact meaning. He may learn its meaning through reading extensively over a long period of time, or he may look it up in a dictionary, or consult his well-trained teacher (if indeed he has one.) But being able to see animated visuals depicting the various use of a word along with example sentences either read or printed on the screen or in both forms at a click of a mouse appears a lot more convenient, and promises much better results.

It should also be noted that once such a package is created, it makes it possible to test the learner's mastery of these words by showing the animated visuals, or visuals along with a test question. Such methods may also be used to supplement or substitute the controversial native language prompts or the never under-used multiple-choice questions.

Cultural elements

From even the very first day of learning a foreign language, the learner begins the never-ending task of learning the culture at the same time. And the amount of cultural exposure often has a direct effect on the quality of the language learning outcome. Learning English in non-native environments presents many difficulties, with the cultural aspects being by far the most difficult.

Many factors--unavailability of materials, strict political censorship, technological underdevelopment--may indeed be responsible for creating such difficulties. The bottom line is that EFL learners oftentimes do not have a clue of what things are like in English-speaking cultures. What is common-place to native English speakers may take the EFL learner years of reading to obtain only a vague idea. Thanksgiving to the average EFL learner in China sounds just as ambiguous as the Moon Festival to American students learning elementary Chinese. The learning of a lot of concepts and facts may be effectively facilitated with static graphics, but when it comes to learning words or expressions denoting procedures, performances, and directional movements, computer animation is clearly the choice.

Computer animation may be used in a number of areas to enhance learning of cultural information. The rich and colorful gestures and facial expressions many Americans adopt while speaking is one such area. It is possible to demonstrate through animation the meaning and use of each and every gesture specific to English speakers, so that EFL learners from Thailand are aware that an American signals "come over here" the way people do to call their pet dog in Thailand. And, EFL learners from China may learn from such programs that what they do in Chinese to mean "I am thinking" is actually interpreted by an American as "you are retarded". With the help of such animation, all EFL learners would be able to make use of the abundant paralinguistic information to improve their understanding of spoken English, as well as to eliminate some of their "foreign accent" in speaking English.

The correct use of silverware and the appropriate table manners are another area that computer animation may be effective for helping EFL learners learn the culture. In addition, digitized video clips of various social occasions, festival celebrations, daily greetings, religious events, and more could be used to create a carefully sampled cultural reality to give more meaning to the EFL learning experience.

Developmental considerations

A number of issues --the choice of programming language or an authoring tool, cultural considerations of target users, operating environment, hardware requirements-- need to be resolved at the initial developmental stage of creating computer animation for EFL use. Answers to these general questions may vary from project to project. However, for each specific event of instruction within a package, the designer is faced with more concrete questions such as "Is animation necessary?", "What type of animation should I use?" and "What other resources should I use along with animation?"

Animation or no animation?

As Rieber (1994) points out, the first principle of the design of instructional graphics is this: There are times when pictures can aid learning, times when pictures do not aid learning but do no harm, and times when pictures do not aid learning and are distracting (p.3). Clearly, the very first decision the software designer needs to make is whether or not to include any animation at that particular point of the program.

Since animation is mainly added to enhance learning, the designer may start a needs analysis by trying to predict the learning effect of animation. Rieber (1994) suggests that animated visuals pass the test of a need for external visualization, and the test of learning dependent on the understanding of motion or trajectory (the direction of movements) (p. 148). The designer should also consider whether animation would help motivate the learner or retain learner interests. If indeed animation is needed, the designer then faces the question of how much (both the size and the duration of the animated object) animation is appropriate. Before reliable empirical data comes up with detailed procedural guidelines, common sense would dictate that brevity reflects good judgment.

What type of animation to use?

The type of animation to be included for a given event depends largely on the function of the animation and the authoring system at use. Unless animation serves to display the results of a learner activity monitoring system, and/or to reinforce, or as a feedback to, learner interaction, data-driven animation may not be needed. Fixed-path animation is generally a lot easier to create and to control. Professional software developers with special training may want to use programming languages like the "C++" to get more versatility. But for producing teacher-made course-related instructional programs, the authors strongly recommend using high-level authoring tools (such as *Authorware, Superlink, Toolbook, & Linkway Live* on DOS machines or *Hypercard* on Macs) and creating fixed-path animation with skillful use of color change and other visual effects.

What other resources to use?

Creating animation can be a very time-consuming process. It is usually a good idea to plan in advance and do some research before starting everything from scratch. Many authoring systems provide good collections of ready-made clip-art and conversion programs for bringing in graphics from other systems. There is also an increasing list of commercially available CD-ROM clip-art collections. Color scanners may also be used to build customized collection of visuals. In any case, making use of existing materials saves time and helps improve the quality of the finished project.

For EFL learning, existing videos and laserdiscs are a gigantic supply of resources. Learning to use the capture function well or becoming skillful with quick video technology would give the designer endless choices of animated visuals to be incorporated into his instructional or practice programs.

With the arrival of the multimedia personal computers into schools and the homes, EFL software designers now have the luxury as well as the challenge to make use of the digitized voice technology to add a new dimension to their programs. Whenever possible and appropriate, voice messages, audio track of the EFL materials being presented, music and other sound effects should be actively adopted to help make the EFL learning environments truly audio-visual, so that the combined effects of the dual codes help bring about the best results.

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