

3-D COMPUTER ANIMATION PRODUCTION PROCESS ON DISTANCE EDUCATION PROGRAMS THROUGH TELEVISION: ANADOLU UNIVERSITY OEF (THE OPEN EDUCATIONAL FACULTY) MODEL

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ABSTRACT

Anadolu University began distance education applications and TV broadcasting related to this concept on 1982-1983 academic year. 3-d (three dimensional) computer animation techniques started TV be used in educational TV programs on 1989, the same year when the Animation Department was established. The Animation Department, which was originally found under the name Electronic Graphics is formed so as to benefit from the production and expression advantages of 3-d computer animation techniques which became wide-spread through technological improvements.

By this study it is aimed to point out how and where 3-d computer animation techniques can be put into work usefully during the process of the production of TV educational programs of Anadolu University OEF. Besides this general goal, to state the position, importance and production levels of animation can be expressed as a sub-goal of the study. This study is limited with the usage of 3-d computer animation on educational TV programs of OEF.

Keywords: Animation, Computer Animation, 3-D, TV Educational Program, Distance Education, OEF, Anadolu University.

INTRODUCTION

Anadolu University began distance education applications and TV broadcasting related to this concept on 1982-1983 academic year. 3-d (three dimensional) computer animation techniques started TV be used in educational TV programs on 1989, the same year when the Animation Department was established. The Animation Department, which was originally found under the name Electronic Graphics is formed so as to benefit from the production and expression advantages of 3-d computer animation techniques which became wide-spread through technological improvements.

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What is Computer Animation?

In this respect, it seems logical to start with the classical definition of animation. Its definition is "to create many stable images which show an object in a movement and to direct us to think as if it moves by the help of playing these images one after the other. [1] Another definition is "In traditional frame-by-frame animation, the illusion of motion is created by filming a sequence of hand-painted cells and they playing the images back at high speeds, typically 14 to 30 [2] frames per second" [3].

As it is understood from these definitions, it is necessary to create image frames which are related to each other to form an animation presentation. In early times, this operation was being made by hand and called traditional animation. Every frame was drawn one by one and then painted by hand on paper, celluloid or film. Even the assistants were comforting the animator by drawing and painting the in-between frames which complete the movement while the experienced animators were drawing the key frames. With this method it is obvious that a 3-4 minute long animation is very troublesome and requires a lot of time when it is thought that a minute animation requires 12-24 [4] frames per second. Another operation which also needs high care is to take photograph each frame one by one by using a movie camera.

The popularity of traditional animation production, which was described above and the increase in perception of some messages by the spectators made the developing technologies inevitable to be used, especially the animation. When computer technology was applied to the animation production, in the beginning, traditional animation point of view was not left aside, developments were reached in transferring two dimensional animation production to computer in terms of time and technical easiness.

In 2D computer animation, animator makes the drawings by the help of digitalizers on a computer screen, not on a paper which is made by hand working. On the other hand there is another possibility that one can transfer the products of traditional animation that were ones produced on paper to computer by scanning. Some primitive drawing forms like square, circle, line and the tools for an artist like eraser, brush, and airbrush are simulated in computer. There is no need for the user who produces computer animation to use a ruler to draw a line, to struggle with the measurements for a milimetric square or to mix different colors to obtain the desired color. These kinds of simple operations are made with a high sensitivity by the computer software. At the end, compute gives the opportunity to the user to get an outcome for his/her animation through a printer, a video, etc.

3-d computer animation is the projecting of two-dimensional pictures one after the other which are rendered in the means of width, length and depth in the space supplied by computer software's. 3-d computer animation has some characteristics that are different from the traditional animation in terms of method and techniques. By the user's commands, the computer calculates the details like movement, color, light, and perspective of the objects on the created visual stage accurately and gives the outcome as an image. Animator plans the model which is thought to be on the stage with architecture sensitiveness, chips into shape with a skill of sculpture, makes it move in aesthetic way by the help of observation, experience and creativeness. While doing this work, his/her brush is digitalizers like mouse and keyboard, his/her canvas is computer screen. His other tools are like modeling, metamorphosis, giving movement; primitive objects, camera, lighting and color materials that the software enables.

What are the Technical and Expression Possibilities of the 3-D Computer Animation?

Producing animation by using computer technology, without doubt, is closely related with the computer technology technique and a series of capabilities of this technique. Computer gives the opportunity to the animator to use time, technique and creativeness at a higher level and enables high quality products to be emerged.

"Computers are used for drawings that animators either can hardly draw or cannot draw by hand. Even if the animators are very good at drawing two-dimensional figures, three-dimensional figures and their movements can challenge the most experienced eyes and hands. If a three dimensional volume is going to be drawn, it is impossible to create the perspective images by hand that a camera can do by moving in this visual environment. The computer can do the entire complex and dense mathematical operations while the camera moves around the described three-dimensional objects or the objects move around themselves. In a similar manner, sensitive light effects can be drawn by hand in one frame;

but these effects must not change in the consecutive images like in video and cinema. Here, computers can do the painting, shading and lighting calculations for appropriate and consistent lighting effects.” [5]

This helps the animator to have more time for creative thoughts and to produce different alternatives. The computer is only a tool during the process of creating. Creator is the man and he produces by using the capabilities of computer softwares. [6]

The capabilities and expression easiness offered by 3-d computer animation and communication technologies, which are hard to keep up with as they develop day-by-day can be explained by the following examples:

- Creating images that cannot be filmed by a camera, like the structure of an atom.
- Creating images that are not possible to obtain in real life, like landing on any desired part of the earth from outer space.
- Reproduction of some works of art, which were destroyed by natural reasons or by men.
- Producing events which require high costs and events which can cause danger like explosion and collision. Creating some products through computer that have not been produced yet.
- Producing moving images generated from graphical materials like photograph, letter font, figure, schema, map.
- Transforming complex events into basic graphical expressions.
- Describing the nature and supernatural phenomenon.
- Animating imaginary and mythological heroes.
- Simulation of laboratory experiments.
- Producing images which look realistic.
- Transforming the abstract thoughts into concrete images.

Producing animation by the help of techniques and expression capabilities offered by the computer technology which described above shortly involves a series of production steps. The brief information about these steps is given below.

Producing Steps of 3-D Computer Animation

In the process of 3-d computer animation production, it is inevitable to realize some series of steps related to production technique and methods based on both technique and expression style. The information about these steps are as follows. [7]

- Design
- Producing the models (modeling)
- Determining the surface qualities of models.
- Scene arrangement
- Transformation
- Rendering the objects
- Assembling and special effects
- Transferring to video, CD, or film.

First of all, an idea must be formed to produce an animation. And design enables the transfer of the idea. “The design process of animation production is a kind of planning process in which the subject of animation, the message to be sent to target population, the method to be followed in presenting the information, time and expression characteristics are all taken into consideration and planned as a whole.” [8] Besides this description, the drafts of characters, models, images and sound which are going to be used in the animation are formed in mind. The event takes its first form with the scenario. Scenario can be thought as the story of the planned design. The event that is going to be told, the message that is going to be given, relations, atmosphere, manner and behaviors all form the text in this step.

3-d computer animation production begins with the modeling of the characters that are thought to have roles in the story. Models are made in the computer's virtual space where width, length and depth are entered with numerical values.

In the first step, a three-dimensional skeleton of the model which seems to be made of wires is made. On the surface of this skeleton color, texture and material features are defined. These features are the simulations of the objects surface characteristics in real life. Animator produces very realistic images by defining the materials to objects like transparent like glass and light permeable, bright like chromium and reflecting light, dull like plastic and absorbing light.

After the surface qualities of the models are done, the scene where the events will occur can be built. A placement is arranged on stage according to the positions of characters, objects and accessories, and their movements that will be performed in a planned time which is determined by shooting script and storyboard. Light sources and cameras are also placed in this section. Virtual cameras and light sources in animation softwares have similar features with their equivalents in real life. However, movements and shows that cannot be made in real life can be done by using the capabilities of a computer. Light sources are placed on the scene according to the kind of atmosphere that is to be created. Lighting density colour values are determined. And the camera is also placed on the stage according to point of view.

Stage arrangement is done in the form that the first frame of the animation is seen. The keyframes of the objects or the characters that are being planned to be moved are placed on the time line. On these specific points, the movements are applied according to the flow of scenario and the effect that the characters must follow.

The places of the intermediary movements between two key frames are calculated by the computer through animation software. The movements on the stage are not limited with only the movements of the characters. With the possibilities of 3-d computer animation software, the places, angles of camera and the color and the density of light sources can be changed by time. Beside this, the images can be obtained that cannot be seen in real life by changing the surface characteristics. For example, a glass vase can be transformed into a vase which is covered with a texture of tree.

The last step is the rendering step, once the scene is designed three dimensionally. By this operation, the defined surface characteristics, by the help of light sources, can be viewed on the computer screen. Producing 3-d computer animation comes to an end by playing all the frames in a sequence.

Using sound, music, effects can take the animation to its goal so easily. Sound and music are the most important elements that support the image. The perception level increases for the audience when the image comes with sound.

The sound that comes from the floor when an object falls down, in a manner that supports the structure of the object on the image, gives information about the object and the floor.

In animation production, the usage of types of sound or music and how and where they are going to be used is planned during design step. If the animation is built upon a narration or music with a specific goal, the movements in the animation are applied in a synchronized way with the edited sound or music. On the other hand, if the sound and music is going to be used to support the images and the events in the animation, then these elements are inserted to animation after it is produced.

After the editing of animation, it is transferred to any medium like film, video, CD, etc. Animation is being used very wide-spread in many fields today which has many steps from design to production.

COMPUTER ANIMATION USAGE FIELDS AND ITS USAGE ON TELEVISION EDUCATIONAL PROGRAMS

On screen sometimes we see dinosaurs, strange aliens that run from one place to another; sometimes we walk in the rooms of a house by the sea that has not been built yet; and sometimes in TV commercials we see logos or products flying and bouncing. These are all made by animation techniques. Computer animation shows itself in different fields everyday. Briefly, these fields are; advertising, architecture, art, archeology, chemistry, education, engineering, entertainment and game, movie, flight simulation, law court, medicine, military, multimedia, scientific animation, simulation, space searches, video and television. [9] In every field, different dimensions of animation are used through its production and expression possibilities. In this part of the study, the applications and goals of computer animation in TV educational programs is going to be told.

What makes animation different from camera image is that each frame of the images that form the movement is made one by one in animation. Single frame doesn't represent the animation. It may be considered as a photograph, picture or illustration by itself. Only when these frames are played at a specific speed the animation presentation is occurred. A medium is necessary for the animation presentation. Video and the computers which can process the image digitally and then can transfer are the appropriate basic media for these kinds of works. By transferring the images through these media, the animation can be shown on computer, television or movie screen.

Movie projection requires specific environments and can reached to a limited number of spectators at a specific time. On the other hand televisions diffuses the electromagnetic waves or broadcast by cable to far and wide places. So, many people, individually or in a group can reach these TV broadcastings. "The goal of distance education systems is to serve students who are in dispersed areas and under the effects of different life conditions" [10] made television a medium to be benefited for distance education. Television is a very rich medium in the means of transferring knowledge and symbols. Knowledge can be transferred very densely. Television is the only medium which brings words together, presents still and motion pictures, transfers an event visually on the time when it occurs, shows via slow motion or rapid motion, uses text. All these provide superiority to television in presenting the information. [11]

Another goal of TV educational programs which aim to serve by means of transferring information to areas where educational and instructional systems, tools and materials can't reach is to teach students by using television's audio-visual and motion properties. For television educational programs to reach this goal, the visual expression elements must be arranged effectively. Because, it is a fact that the programs will be more instructive and there will be an increase in the rating if these elements are arranged effectively. [12] Animation is an audio-visual material since it can be supported by sound. As it is known, audio-visual materials have an important role in educational and instructional environments. Audio-visual materials generally have these five features: [13]

- 1- Capability of improving perception,
- 2- Capability of improving understanding,
- 3- Capability of developing learning transfer,
- 4- Capability of consolidating obtained learning results,
- 5- Capability of helping to keep the learned knowledge in mind.

The main reason for the frequent usage of audio-visual materials on television educational programs is to contribute effectively for the students to make real their learning objects. [14] It became inevitable to use animation in education field since it includes audio-visual materials' determined capabilities.

THE PLACE AND THE ADAPTATION COMPUTER ANIMATION APPLICATIONS IN THE PRODUCTION PROCESS OF OEF TELEVISION EDUCATIONAL PROGRAMS

Like in most of the distance education systems, some in the OEF, the printed materials, which include information and concepts, are delivered to students. These contents of the printed materials are visualized and diffused through television broadcast to its target population.

Television educational programs are produced due to a specific need. The main object is to reach the students who live in wide-spread areas and transfer the knowledge to them through a specific aim. Preparation and production of television educational programs are realized step by step in a process. Kılıç states that this production process can be set up in an order like this; planning, preparation for taking footage and adaptation for TV. [15] Planning is the step that the target population is determined and also the kind of knowledge that will be transferred and method of transferring knowledge is determined. In this stage, instructor (expert of the subject), director and the scriptwriter come together and do a common work. As a matter of fact, the target population is known for OEF TV programs. While the instructor prepares the answer for the questions "what knowledge will be given", on the other side the director and the scriptwriter try to come to a common idea to determine the method of giving the knowledge. Kılıç classifies the preparation for taking footage as writing the scenario, determining the television program elements and determining the technical capabilities. Kılıç also states that the scenario is the essence of television educational programs, and progress and the manner of being together of all events occur in scenario. [16] "Before writing the scenario which is designed to include the form and flow of projection the content of the program and important production knowledge", television program elements must be determined [17]. These elements, are people, objects, location sound, graphics and image material which will be included in the program. [18]

In a television educational program, the idea to benefit from the capabilities of animation occurs during this step. The director, by taking into consideration the other alternatives, decides to use animation in the program in the direction of expression properties and the benefits of animation. The thought is developed where and what kind of animation is going to be used in the program.

The people who plan the educational television program do not have to know the technical details of animation production. But if they are aware of the technical capabilities and limits, they can be more creative, and as a result this lets the students take better advantage of programs.

After the thought step, the technical capabilities are examined to see if they are sufficient for the desired animation. In order to do this, producer-director goes into a dialog with the animator. In most of the television production companies, this dialog is established with the art director. The art director is the one who knows the technical capacity, produces creative thoughts and the producer-director exchanges ideas with each other, they transfer the data to the animator who will realize the application of this work. In OEF, the animator directs the animation instead of the art director. Producer-director directly communicates with the animator. During this interaction the animator is informed about the event that he is asked to animate. Information like what kind of expression is desired, total time of the animation and the period that the animation must be produced is given to animator.

The application of the developed idea is going to be wanted from the animator. An ideal animator who will take part in division of labor before and after the process of taking footage must be well educated, creative, a good observer, having practical thoughts for solving problems and alternative methods. Even the animator is complete in every respect, he will be limited with the capability of computer and the software.

After determining the elements that is required for television educational programs like narrator, set decoration, light, graphics, make-up and the technical possibilities, the scenario is written by the help of the thoughts and knowledge which was constituted during the planning step. The process of writing scenario includes every element related to image and sound. [19]

The process after writing the scenario is transferring the scenario to television program environment. In order to this, a shooting script is prepared. And this script includes all the required information to realize the program, such as shooting angles, natural sound, music, dialogs, graphics and information about the animation like its duration.

The process for producing animation starts with the decision to realize the animation. The details and its duration are determined after its position in the shooting script becomes definite. Generally, the animation is used during the editing process after taking the footage. In the editing process image and sound arrangements are made according to scenario. Sound and music are synchronized with the images from the archives, newly shot footage, graphics and animation through some special effects, according to the wishes of producer-director. In these kinds of situations, the process of animation production continues through the process of taking filming and it is possible to work on it till the editing process begins. But, in some cases animation can be used during the filming step. This can be a live broadcast production or it may be planned usage of animation during the footage. In these cases, the animation must be ready before the filming starts.

The animation starts with the design which includes the formation of thought. Producer-director explains his/her thoughts to the animator by a storyboard. If he doesn't have a preparation like this, he interviews the animator by giving him the information and the materials related to the subject. He wants a storyboard from the animator which shows the direction that the animation can develop and what kind of a possible event flow can occur. By the method of storyboard, a preliminary knowledge is given to the producer-director by simply visualizing the setting arrangements of characters and their motions. Furthermore, it supplies a foresight of the problems and contradictions that can come out in the future. In this way the storyboard provides the work to go forward in a planned way by giving animator an idea to follow a method. After the producer-director approves the proposed design, the production process for animation begins.

Animator works separately from the other production elements, if a necessary condition doesn't occur. The objects (character, logo, accessory) planned to take part in the animation is modeled on the computer. The features and surface characteristics are determined. The scene arrangement which will be seen on the screen is made. The objects are placed on the scene to form the first frame of the animation. Desired effect is obtained by producing the light sources to illuminate the scene. The location of the camera is determined for the point of view. The motion is created. The computer realizes the painting process of the scene, which is produced by digital information, according to the values of camera, light and material characteristics of models by calculating. The animation production is completed after it is transferred to a medium environment to be projected. Television education program takes its last form by editing which is done according to scenario.

3-D COMPUTER ANIMATION APPLICATION ON OEF'S TELEVISION EDUCATIONAL PROGRAMS

A Short History of Animation Applications and Technical Hardware

OEF started educational courses on Television on 1982-1983 academic year. But the preparations for production process are based on former years. In the first works, graphical elements were denser at the limits of technical hardware of those days. Photographs, real images and hand-made caricatures, illustrations and schemes were used. Consecutive images, like caricature and illustration that are drawn in some numbers are used for the events that must be shown gradually. By these kinds of practices, animation technique was tried to be obtained on OEF educational programs. Special video effects like wipe, mix and

color cycle were started to be done and also motion was created on formation of letter character style by the help of a character generator called Chyron which was assembled in 1984. This device was able to draw, paint and erase the objects and also it could do zoom-in, zoom-out and move the objects. So this was the beginning for electronic animation production in OEF.

3-d computer animation technical hardware and equipment with software PictureMaker 2.0 was constituted in OEF in the late 1988. After a short in-service education for the operators to use this DOS based software, it was started to make use of it in 1989. This technical hardware, which was very expensive, was slow in image processing and had limited production capabilities though it was a pioneer among its equivalents on those days. Later, the cost of the computers began to decrease while the processors of the computers began to improve and the AutoDesk Company developed software and put it on the market in 1993 called 3D Studio, which enabled to produce animations on personal computers. From that day on, animation production for OEF educational programs has been produced by this software.

3-d animation software's which have developed each day parallel to technology has been followed in OEF and the present system performance has been improved when needed. Today, 3D Studio Max v.2.5 is being used for the 3-d computer animation production which is also developed by AutoDesk under a company named Kinetix. Animations are transferred to video players from computer by TARGA2000 Pro and Matrox DigiSuite LE video capture cards in real time. And the hardware is double processor Pentium II 400, 256 Mb RAM with a 8 Mb Elsa Gloria Synergy graphics card.

3-D Computer Animation Applications

It is seen that the production of particularly 3-d computer animation began in 1989 as seen in the information given above. It is possible to have an investigation about the animations, where and how they were used in the programs since that day. It was designated that producer-director is the one decides to use animation and how and where in an education program it will be seen. Animator is the one who has the creative and aesthetic approaches and also alternatives to direct the event and do the production.

When OEF education programs are examined, 3-d computer animation is firstly seen in the credits. Credits are also known as the introduction writings of the program. It can be produced only by using letter characters or still and motion pictures or special effects. It is inevitable to use computer animation, because of the high interest in flying bright three-dimensional writings, characters and special effects which has been used in advertising, TV and cinema very frequently.



Figure: 1

And it is also attracting to use computer animation in credits since the computer can combine real images with the ones that computer generates.

There isn't any certain rule for OEF education program credits. Credits by animation is realized through a style that producer-director determines or according to the creativeness

and aesthetic approach of the animator. But, the name of the course and the subject title is definitely included in the credits. If desired, the images and the effects which will be used with the title are designed to support the content of title and course.



Figure: 2

3-d computer animations are not only used in the credits but also inside of the programs. It is possible to see moving letter characters in many programs. Texts like descriptions, titles are used on the bottom of the screen while the real images keep on running and these can also be written on a background that is produced by computer. In addition, it is seen that some symbols and abstract thoughts are represented by writings. In an example, "benefit" and "loss" words were placed on the two pans of a computer-made balance. At first the colors of the words were same. When the positive developments increased in the event, the color of "benefit" word changed and that made pan become heavier. In opposite, the same operation was done for the "loss" pan. In another example, information was described as walking around in a labyrinth which was made of stone walls. When it is examined generally, it is seen that the animations which include graphical and real images has been used in health, anatomy, physics, chemistry based programs. Flow of blood, heartbeat, structure of skeleton and similar situations have been simulated by animation for the courses which have contents like health and anatomy. And for physics and chemistry based courses some other animations have been used which simulate the effects of gravitational force, acceleration and slowing down of objects. We can have an example for arm muscle. A human arm was animated three dimensionally like a mechanical arm with its joint parts and covered with muscle simulation. Inflation of the muscle after bending the arm up with a weight in the hand and the reverse movement, deflation and stretching of the muscle could be shown by animation. Computer animation technique was also used to get the images that cannot be filmed in real life or cannot be seen like the structure of an atom, the movements of electrons. And these images were used in the programs.

Schema and graphical elements were used in the programs which required content related to number, planes, curves. The values that obtained through numerical data were shown with the animations like moving, color changing and varying lines, curves and figures. In these kinds of works, many elements like figures and curves may be necessary to be used together. In such cases, the screen must be organized in a simple way to keep the perception and learning via screen easy. The depth, which is an element of main factor of third dimension, is removed for the objects which are animated for this goal. Animation is realized as surface a object that gives the feeling of two dimensions even it is produced by the same production facilities of three dimensional.

CONCLUSION

Animation has an important place among the production and visualization methods of television education programs. When an animation is used appropriately, it has an effectual expression style in supporting learning. Besides the entertaining feature, it has some other characteristics like to make the unseen visible and making the abstract thoughts concrete. Any event or image can be produced by computer very close to its real appearance.

The characteristic of TV is that its ability to transfer audio-visual materials enables animation presentations. This feature made is inevitable to make use of the advantages of animation in TV educational programs which were produced with a simple, smooth and understandable method.

Animated image has direct influences on the learning and understanding skills since it has the motion feature besides having the other features of audio-visual materials. On the other hand, the idea of benefiting from animation came to an upper level since animation has the ability to show events that cannot be obtained in real life and the ability to show some events step by step.

After the examination of production and expression possibilities of animation through computer, the fields of usage of animation on TV educational programs can be determined as follows:

1. In the credits of TV education programs.
2. Inside the TV programs.
 - a- Visualized events that cannot be filmed with a camera in real life.
 - b- To bring alternatives to productions, which can cause dangerous results and high costs.
 - c- To describe the abstract thoughts in a concrete way by using the features of realistic or graphical expressions.
 - d- To attract the attention of the audience by giving a richer expression to its ordinary way.
3. To use animated image instead of a real narrator.
4. To reproduce the whole stage that the narrator will take part or to give motion the moving accessories on stage.

A development in the communication technology makes it inevitable to use computer softwares in educational environments. Whatever the method is, these usages aim to stimulate one more perception center of the student or to stimulate the perception centers more in a learning process. For the students, during the process of benefiting from the TV programs of Anadolu University OEF, the animation presentations, in terms of visibility, attractiveness, arousing attention, easiness in perception and learning become so effectual. TV programs can be presented in an interactive and effective way by getting rid of the manner, which bores the students.

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REFERENCES

ELLIOT, S., MILLER, P. (1999) *Translator: Milimetre Ceviri Grubu. 3D Studio Max 2, Sistem Yayıncılık Mat.San. ve TIC. A.S., Istanbul.*

GUCHAN, N. (1988) *Sistem Yaklaşımı ile Televizyon Eğitim Programı Yapımı–Acikogretim Fakültesi Örneği-[Production of Television Educational Program by System Approach]. Anadolu Üniversitesi Acikogretim Fakültesi Yayınları, Eskisehir.*

GURSAC, Y. (1993) *Uc Boyutlu Bilgisayarlı Animasyon ve Yaratıcılık İlişkisi [Three Dimensional Computer Animation and Creativity Relation], Yayınlanmamış Yüksek Lisans Tezi [Unpublished MA Thesis], Anadolu Üniversitesi Sosyal Bilimler Enstitüsü, Eskisehir.*

_____. (1999) *Bilgisayarda Uc Boyutlu Animasyon Film Üretimi -Bir Basına Oyun Film Uygulaması-[Production of Three Dimensional Animation Film on Computer–Application of Solitary Game-], Yayınlanmamış Sanatta Yeterlik Tezi [Unpublished Doctoral Thesis in Art], Anadolu Üniversitesi Sosyal Bilimler Enstitüsü, Eskisehir.*

GURSES, N. SAGLIK, M. (1998) "Uzaktan Öğretimde Televizyon ve Televizyon Öğretmenliği [Television and Television Teaching in Distance Education]", *Türkiye İkinci Uluslararası Uzaktan Eğitim Sempozyumu Bildiriler–Türkiye Second International Distance Education Symposium-Papers*, MEB Film Radyo Televizyonla Eğitim Başkanlığı, Ankara.

KARATIMUR, B., Yeşil B. (1998) [Green Cloud], Yayınlanmamış Sanatta Yeterlik Tezi [Unpublished Doctoral Thesis in Art], Marmara Üniversitesi Sosyal Bilimler Enstitüsü, Eskisehir.

KILIC, L. (1985) *Eğitim Televizyonunda Yapımcı-Yönetmen [Producer-Director on Educational TV], Anadolu Üniversitesi Acikogretim Fakültesi Yayınları, Eskisehir.*

OZDIL, I. (1985) *Uzaktan Eğitim Teknolojisi [Technology of Distance Education]. Anadolu Üniversitesi Acikogretim Fakültesi Yayınları, Eskisehir.*

OZGUC, B. (1995) "Görüntünün Matematigi [The Mathematics of Image]", *Bilim ve Teknik Dergisi*, Mart 1995, Sayı: 328.

OZGUR, A. Z., OZTURK, S. (1998) "Televizyon Eğitim Programlarında Yapım Biçimleri ve Görselleştirme Boyutu [Production Formats and Visualization Methods in TV Educational Programs]", *Türkiye İkinci Uluslararası Uzaktan Eğitim Sempozyumu BİLDİRİLER–Türkiye Second International Distance Education Symposium Papers*, MEB Film Radyo Televizyonla Eğitim Başkanlığı, Ankara.

<http://www.alkenmrs.com/video/standards.html> (visited in May 2001)

<http://www.bergen.org/AAS/ComputerAnimation/> (visited in May 2001)

<http://encarta.msn.com> (visited in May 2001).

FOOTNOTES

[1] ELLIOT, Steven; MILLER, Phillip. *Translator: Milimetre Ceviri Grubu. 3D Studio Max 2, Sistem Yayıncılık Mat.San. ve TIC. A.S., Istanbul: 1999, s. 44.*

[2] 14-30 frame per second projection speed is valid for NTSC Video Broadcasting Systems. For detailed information: <http://www.alkenmrs.com/video/standards.html> (visited in May 2001).

[3] <http://encarta.msn.com> , (visited in May 2001).

[4] 12-24 frame per second projection speed is valid for PAL Video Broadcasting System. For detailed information: <http://www.alkenmrs.com/video/standards.html> (visited in May 2001).

- [5] OZGUC, Bulent. "Goruntunun Matematigi [The Mathematics of Image]", *Bilim ve Teknik Dergisi [Journal Science and Technics]*, Mart 1995, S.328, s. 22.
- [6] For detailed information: GURSAC, Yucel. "Uc Boyutlu Bilgisayarli Animasyon ve Yaraticilik Iliskisi [Three Dimensional Computer Animation and Creativty Relation]", Yayinlanmamis Yuksek Lisans Tezi [Unpublished MA Thesis], Anadolu Universitesi Sosyal Bilimler Enstitusu, Eskisehir: Haziran 1993, s.68-70.
- [7] GURSAC, Yucel. Bilgisayarda Uc Boyutlu Animasyon Film Uretimi -Bir Basina Oyun Film Uygulaması [Production of Three Dimensional Animation Film on Computer --Application of Solitary Game-], Yayinlanmamis Sanatta Yeterlik Tezi [Unpublished MA Thesis], Anadolu Universitesi Sosyal Bilimler Enstitusu, Mart 1999, s.10.
- [8] KARATIMUR, Binnur. Yesil Bulut [(Green Cloud), Yayinlanmamis Sanatta Yeterlik Tezi [Unpublished Doctoral Thesis in Art], Marmara Universitesi Sosyal Bilimler Enstitusu, 1998, s.46.
- [9] For detailed information: <http://www.bergen.org/AAST/ComputerAnimation/> (visited May 2001).
- [10] OZDİL, İlhan. *Uzaktan Egitim Teknolojisi [Technology of Distance Education]*, Anadolu Universitesi Acikogretim Fakultesi Yayinlari, Eskisehir:1985, s.18.
- [11] GURSES, Nedim. SAGLIK, Mediha. "Uzaktan Ogretimde Televizyon ve Televizyon Ogretmenligi [Television and Television Teaching in Distance Education]", *Turkiye Ikinci Uluslararası Uzaktan Egitim Sempozyumu BILDİRİLER -Turkiye Second International Distance Education Symposium-Papers*, MEB Film Radyo Televizyonla Egitim Baskanligi, Ankara: 1998, s.209.
- [12] OZGUR, A. Ziya. OZTURK, Serap. "Televizyon Egitim Programlarinda Yapim Bicimleri ve Gorsellestirme Boyutu [Production Formats and Visualization Methods in TV Educational Programs]", *Turkiye İkinci uluslararası Uzaktan Egitim Sempozyumu BİLDİRİLER-Turkiye Second International Distance Education Symposium Papers*, MEB Film Radyo Televizyonla Egitim Baskanligi, Ankara:1998, s.253.
- [13] OZDİL, ibid., s.44.
- [14] Ibid.
- [15] KILIC, Levent. *Egitim Televizyonunda Yapimci-Yonetmen [Producer-Director on Educational TV]*, Anadolu Universitesi Acikogretim Fakultesi Yayinlari, Eskisehir:1985, s.52.
- [16] KILIC, s.54
- [17] GUCHAN, Naci. *Sistem Yaklasimi ile Televizyon Egitim Programi Yapimi -Acikogretim Fakultesi Ornegi- [Production of Television Educational Program by System Approach]*. Anadolu Universitesi Acikogretim Fakultesi Yayinlari, Eskisehir: 1988, s. 65.
- [18] KILIC, ibid, s. 60-62; GUCHAN, ibid, s. 57-63.
- [19] KILIC, ibid, s. 54.