

# ***Computer Aided Animation Techniques for Educable Mentally Retarded Children***

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## **Abstract**

Technology and technology based developments affect almost every discipline such as art, communication, education, literature, etc. Art has also been influenced by technological advances for centuries. Technology provides interdisciplinary approaches in terms of art and education. Art, education and technology become more efficient in terms of functionality when supported by music. Using computer-aided animation in teaching both academic skills and concepts in special education is important for supporting education with visual aids. When auditory and visual elements are used together, learning becomes more permanent and effective. Computer-aided applications can be an alternative education model since they are renewable, updatable, and storable. This study is the first digital-based education model designed for the development of auditory and visual perception of dedicatedly educable mentally retarded children.

**Keywords:** *Animation, educable mentally retarded children, special education, music, visual arts.*

## **1. Introduction**

Beginning of the development of computer technology and after accelerated the development in graphics. In order to understand the development in computer technology and informatics, digitization should be comprehended first. Digitization is a process that forms the basis of IT and computer technologies. With the “Mathematical Theory of Communication” Shannon-Weaver put forward in 1948 for the first time, communication was expressed by means of 0 and 1 and the way of digitalization in communication emerged. Expression of the systems by 0 and 1 constitutes the basis of IT and computer technologies. Advances in

computer technology have led to proliferation of animation applications. First training and practice on the animation began to be undertaken in Turkey in the 1950s. At that time, animation had not been represented sufficiently in the cinema and the arts sector due to reasons such as high investment costs, requiring much struggle and team work. Animation which has much represented in advertising sector in the coming years has also begun to be used for educational purposes in a widespread manner. It is seen that the developments in technology and communication has increased the importance of digitization concept in Turkey after 1980.

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These new approaches influencing art and artists revealed new techniques and searches other than familiar methods and practices in teaching. This helped the educators to access many resources, knowledge, and images around the world and educators have begun to express many existing objects or phenomena in their works by using the new expression languages. Animation has become an important means of expression by which technology and digital-based studies are produced, extraordinary expressions are designed and demonstrated and many different expressions and forms like these can be achieved for education. Animation, as a branch of art we find the first samples in the 1900s, has been used for different purposes for over a hundred years. In this context, animation emerges as an innovative method in education.

## **2. Animation Techniques**

The initial samples of animation began to be produced in the early 1900s, and for nearly 100 years, animation art, being implemented for different purposes, has been improved with new techniques and methods in conjunction with changes and advances in technology. As an example, internet had such an importance in animation technology and as it was scattered all around the world, web animation gained popularity.

In 1989, CompuServe released GIF89A, an enhanced version of popular GIF image format which allowed a sequence of frames to be stored as a single image played by supporting software. The GIF format became popular due to its small fill size, lossless compression, and wide support. In addition to GIFs, browser vendor's added support for proprietary HTML elements that handled animation natively, such as new elements, was added to system. By late 1990s, Dynamic HTML (DHTML) was

developed which allowed scripting languages to modify the contents of a page after the page was loaded (Wellman, 2011). Nowadays, animation is used in accordance with many different disciplines such as engineering, health, construction and advertising. Animation, considering the most common techniques, is classified into three groups in this paper which are traditional animation technique, stop-motion animation technique, computer aided animation technique and other animation techniques.

### **2.1.1 Cell Animation Technique**

Traditional animation gathers attention among animation techniques as a known and applied technique. Traditional animation is also named as classic animation or cell animation. Cell animation is the implementation of bringing several layers that is cells together in sequence. Cells are drawn on transparent paper manually by animation artists. Each cell represents different scenes or objects that are used in animation (Sandrew Barry, Hamby, 1990). Cell animation is created upon the principles that 24 frames per second will pass in sequence and two successive images must be almost same. The first movement and the last movement are named as the main action. Cell animation is done by using transparent papers in standard sizes perforated according to the pins on the lighted table. To ensure the overlapping of movements on the drawing corners of papers are marked with "cross" (+). For a movement of 1 second, 12 pictures are drawn beginning from the main action and by the inverted repeat of the movement 24 frames are reached. After completion of the main and intermediary movement drawings, the act validity and compliance with background are checked. (Kahraman, quoted from Tezcan 2013, 70)

### 1.1.2 Stop-Motion Animation Technique

Stop-motion animation is the process of photographing any moveable object in the form of subsequent frames and constructing to complement each other. Many object images are set as digital or analog across the camera in this technique. Stop-motion animation technique is generally to give the impression of moving to stationary objects. The second movement is shot after the previous movement. After the obtained images are assembled, image occurs.

Stop motion animation is created by fast flowing of so many frames like puppets or etc. (Kahraman, quoted from Yildiz, 2013, 74). Stop-motion animation is one of the most demanding animation techniques requires to be worked on meticulously. Even the simplest applications that will be prepared with stop-motion animation technique require patience and precision (Barry 2010, 7).

The first movie shot with stop-motion animation technique is “The Humpty Dumpty Circus (1897, USA)”. Albert E. Smith, who used acrobats and animal toys in the film, made the toys moved in every scene and completed the film. (Guinness World Records, 10.04.2015). Today, animation artists like Adam Elliot, Tim Burton, and Will Vinton perform animation works with this technique.

### 1.1.3 Computer Aided Animation Technique

Computer aided animation, in general, is the process of creating visual effects and imposing motion by using graphic tools in computers (Doyle, 2001, p. 30). Advances in computer technology, being reflected in the animation concept, have facilitated and popularized the animation applications created by computers. Opportunities to merge real images, graphics,

texts, real sound and animations especially with computers in which the multimedia technologies are integrated provide many benefits to use animation interdisciplinary. The first developments of computer-aided animation date back to the 1970s. The works carried out by Ivan Sutherland, Dave Evans and Ed Catmull at the University of Utah were providing innovative methods such as texture mapping, that is wrapping onto a three-dimensional object. Catmull continued to work as a computer graphics lab manager in New York Institute of Technology (NYIT) in 1974 due to reason that adequate resources were not provided in the University of Utah. Catmull focusing on the 2-D animation in New York Institute of Technology (NYIT) developed a tool named as “Tween”. This tool was used to draw frames added intermediary from one key to another. NYIT also presented “scanning and coloring system” on the drawings. This system was developed later and formed into Disney’s Computer Animation Production System (CAPS).

In 1976, James Blinn from Jet Propulsion Laboratory brought new variations on texture mapping technique and the technique called bump mapping made possible to coat dented surfaces on the computer. By 1980s, researches on computer aided animation showed an increase and technology-based project producers such as Lucas film, Pixar, Disney, Dreamworks, and so on produced innovative works other than the universities. In 1989, an animated film called Knick Knack, a film about the life of people in the glacier world, has won an Oscar for the first time. (Whitehead 2012, 124-125). We can say that the computer aided animation is a demanded animation technique today and it has several applications for different disciplines. Computer aided animation technique is also

being used in many areas out of the art such as medical technologies, medicine, engineering, institutions and organizations working technology-based, education, and so on.

**1.1.4 Other Animation Techniques**

Although traditional animation (classical animation or cell animation), stop-motion animation and computer-aided animation are mentioned as the most commonly utilized techniques when the animation techniques are classified, less represented techniques can be evaluated under the title of other animation techniques.

Paint-on- glass animation, pinscreen animation (the applications made on the nails), drawn-on-film animation, and sand animation can be evaluated as other animation techniques. (Kahraman 2013, 95). Paint-on-glass animation is based on the principles of animation artist’s application of different painting techniques onto the glass and the movement of and changing images. Pinscreen animation can be described as recording the effects of hundreds of nails generate on the platform through the camera. Drawn-on-film animation is also known as animation without camera or direct animation. Length images are created directly on the film stock in contrast to other types of animation techniques in which images or objects are photographed frame by frame with an animation camera. Since the area used in these works is relatively small, it is used for limited drawings (Kahraman, quoted from Taylor 2013, 96). Animation through sand composes of varying objects animation artist created on the sand. It is not a common animation technique used for demonstration purposes. Changing drawings on the sand can reach the visual aesthetic levels to arouse viewers’ admiration.

**3. Using Computer Aided Animation for Educable Mentally Retarded Children**

Individuals with mental retardation have, by definition, limited intellectual development with concurrent deficits in adaptive areas such as communication, self-care, home living, social skills, community use, self-direction, health and safety, functional academics leisure with an onset before the age of 18 years. Persons identified as mentally retarded are often not learning the same things at the same rate as persons who are typically developing. Like anyone, they have same desires, anxieties, aspirations and frustrations but they may not express those desires or articulate what they need adequately.

*Table 1. Five Assumptions Essential for the Application of the Definition*

1	<i>Limitations in present functioning must be considered within the context of community environments typical of the individual’s age peers and culture</i>
2	<i>Valid assessment considers cultural and linguistic diversity as well as differences in communications, sensory, motor and behavioral factors</i>
3	<i>Within and individual, limitations often coexist with strengths</i>
4	<i>An important purpose of describing limitations is to develop a profile of needed supports</i>
5	<i>With appropriate personalized supports over a sustained period, the life functioning of the person with mental retardation generally will improve</i>

Source: Luckasson et al., 2002

The level of obeying instructions and support they need are used to characterize persons with mental retardation. The cause or type of disorder, the availability of training or instructional technology and the ability of early intervention are combined to determine ability levels. Many individuals with mental retardation do or can develop capabilities in some areas. Other individuals have pervasive disorders in many life areas that remain underdeveloped. However, mental retardation is not considered as a curable or time – limited disability. The condition, by definition, continues throughout the person’s lifetime (Werts, Culatta, Tompkins, 2007).

Educable mentally retarded people cover the lightest group among the three groups of people with mental disabilities related to the intelligence points they have. Educable mentally retarded children are children with IQ scores of 50-70 and limited academic skills and they are more active in the areas such as cognitive, functional, self-care, basic skills and academic skills, social adjustment and so on compared to trainable and severe mentally retarded children.

Today, many studies are performed to develop mentally disabled children’s skills. In 2010, one province each from the east and west of Turkey was determined and a research was conducted to measure the level of ability to relate auditory perception with visual elements of educable mentally retarded children with birth ages between 7 to 11 (Yilma, 2010). The study involved 50 educable mentally retarded children. Five tests are offered each consisting of 10 questions, printed in color on an A4 paper, with 2 and 3 options. Each question played a different sound; the child was expected to mark the relevant image. In other words, test questions are given in the

form of music and the answers are given in the form of images. The result obtained from the *Environmental Sounds Test*, third of the applied tests, is as follows:

**Table 2.** Images and Sounds in the *Environmental Sounds Test*

	Options and Images	Played Sound	Expected Answer
<b>Question 1</b>	a) Dog b) Bird c) Laughing Baby	Bird Sound	Option “b”
<b>Question 2</b>	a) Cat b) Cow c) Girls Swimming in the Sea	Cat Sound	Option “a”
<b>Question 3</b>	a) Clock b) Crying Baby c) Bell	Bell Sound	Option “c”
<b>Question 4</b>	a) Dog b) Drum c) Helicopter	Dog Sound	Option “a”
<b>Question 5</b>	a) Cow b) Laughing Baby c) Cat	Baby Sound	Option “b”
<b>Question 6</b>	a) Clock b) Harmonica c) Traffic	Clock Sound	Option “a”
<b>Question 7</b>	a) Bird b) Donkey c) Flute	Donkey Sound	Option “b”
<b>Question 8</b>	a) Sea b) Piano c) Clock	Sea	Option “a”
<b>Question 9</b>	a) Donkey b) Cow c) Drum	Cow	Option “b”
<b>Question 10</b>	a) Bird b) Violin c) Helicopter	Helicopter	Option “c”

**Table 3. Results of Environmental Sounds Test**

	N	Min.	Max.	Mean	S.s	K-S
Environmental_Sounds	50	2,000	10,000	7,900	1,961	0,090

According to Table 2, distribution of educable mentally retarded children’s visual perception of environmental sounds shows their response to 8 from 10 environmental sounds they listen to. In other words, it can be said that an above average significant difference is found in the images they match in accordance with the sounds they listen to. Children answered correctly to 8 of 10 questions in average. Also, it was observed that educable mentally retarded children try to make sounds and imitate various sounds like the environmental sounds they listened during this test. (Example: bird sound, bird imitations, uttering like the birds; the sound of a helicopter, flying behavior, uttering like the helicopter; the sound of cow, uttering like a cow etc.).

**Table 4. Distribution of Environmental Sounds Test According to Ages of Educable Mentally Retarded Children**

Dependent Variable	(I) Age	(J) Age	Difference of Means (I-J)	Std. Error	p
Environmental_Sounds	7	8	-0,792	0,882	0,896
		9	-1,829	0,898	0,266
		10	-2,505	0,855	<b>0,040</b>
		11	-0,762	0,919	0,920
	8	7	0,792	0,882	0,896
		9	-1,036	0,797	0,692
		10	-1,713	0,747	0,166
		11	0,030	0,819	1,000

Environmental_Sounds	9	7	1,829	0,898	0,266
		8	1,036	0,797	0,692
		10	-0,677	0,767	0,902
		11	1,067	0,838	0,709
	10	7	2,505	0,855	0,040
		8	1,713	0,747	0,166
		9	0,677	0,767	0,902
		11	1,744	0,791	0,196
	11	7	0,762	0,919	0,920
		8	-0,030	0,819	1,000
		9	-1,067	0,838	0,709
		10	-1,744	0,791	0,196

According to Tukey’s test results, the different responses of educable mentally retarded children between 7 to 11 years of age to environmental sounds test according to their ages are seen in Table 3. Accordingly, it is seen that 10-year-old educable mentally retarded children’s musical perception associated with environmental sounds is higher than the 7-year-old educable mentally retarded children’s musical perception of environmental sounds ( $p < 0.05$ ).

#### 4. An Auditory and Visual Perception Correlation Analysis Application for Educable Mentally Retarded Children

Based on the results obtained in 2010, a computer-based digital media module was created. As a digital teaching material, modules are configured in four different types. Each module involves a different topic such as soundscape, beat perception, identification of musical instruments and environmental sounds. They also contain original sound effects and images. To create images Photoshop CS4 software was used. Images, computerized with scanner, are colorized with Photoshop CS4. Colors are descriptive facts in design of images which are vivid and catchy. So, it can be said that by images educable mentally retarded children’s visual perception can be

measured. Sounds also play an important role in the perception of subjects other than the image in the modules. The objective here is to be able to hear recognize the sounds recorded by voice recorder (unprocessed) and to match them with the images exist in our daily lives and shown on the computer screen. The true - false cases of the answers / options preferred will be identified with sound effects. If the answer is correct applause and a green screen, and if the answer is incorrect negative sound effects and red screen are thought to be. When students or music instructors click on the image, sound effects will play.

Elements that must be included in a teaching material such as target, gain, content, and evaluation exist in the proposal of digital teaching material prepared for the educable mentally retarded children's special training music lessons. According to this, each module has a name, a subject and gain. Module names are divided into two sub-groups, and humans, animals, musical instruments, environmental sounds, vehicles, weather conditions are presented with sounds and visuals to the students through each title. This section consisting of 10 samples composes the introduction (content) part of the module. Each module has a measurement and evaluation part. A 10-questioned, each question with two options, mini quiz is applied related to the subject of the relevant module. Modules end with an animation clip related to the topic considered as a reinforcement tool. 1-2 minute rhyme written in the form of a song, and a character drawn by 2D / 3D animation technology are planned to help treating the subject of the relevant module.

All of the modules in a work environment will be accompanied by a music teacher. Teacher will play an issue handler role in 1<sup>st</sup> and 2<sup>nd</sup>

Sections of the module. Teachers can define and talk on the image incoming with the audio when the corresponding the image is clicked. In the assessment and evaluation part, they can ask question/ questions of "Which image is the expression of the sound we hear?" to focus the student's attention. Teachers play a narrator role here. Modules must be conducted in a one by one working environment with a music teacher and a special education teacher.

#### 4.1. Technical Structure

This program is an executable PC program which is designed to work on a PC. The project is created by using .Net architecture and programing language. As database management system MSSql is preferred and special reporting prepared in Microsoft Reporting.

#### 4.2. Technical Properties

This program consists of four technical modules basically. These are:

1. Image Processing Engine
  - It defines the infrastructure of system
  - It provides all visual and auditory items to be managed by operator. And it also provides to be played in calculating times.
  - It is for management of all visual and auditory processes
2. Designing Module (Figure 1)
  - It provides anything shown on system such as images, sounds and writings step by step.
  - It provides to prepare parameters that every object can get a chance for educable mentally retarded children
  - In the last of impression, it provides quantification questions for the analytical results.
  - It provides a modular notation and a testing structure (Figure 2).

### 3. Display Module

- It provides showing visual and auditory images chosen in design module (Figure 3).
- It provides assessment and evaluation of testing on educable mentally retarded children (Figure 4).
- It provides compiled demographical properties for educable mentally retarded children.

### 4. Reporting Module

- Monitors the assessment results of visual and auditory elements.
- Operating to decision support systems.

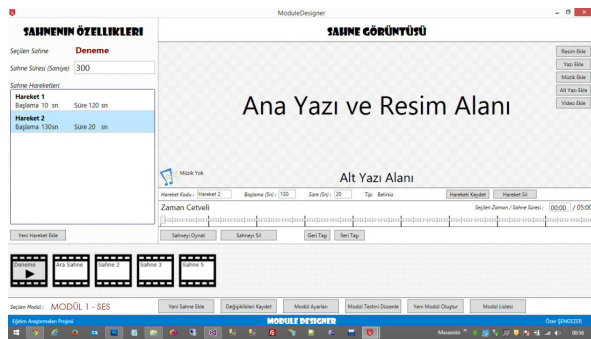


Figure 1. Designing Module

### 4.3 Utilization Targets

- The operator can create a plan for educable mentally retarded children with visual and audio elements.
- The operator can put in to place the impression plan and make the analysis of the questions.
- Modules of generated plan are utilized within the structure (Figure 2).

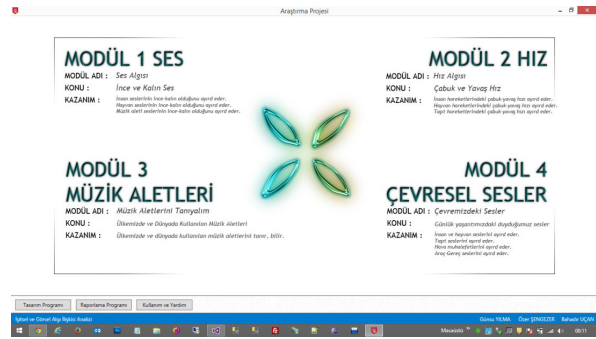


Figure 2. Modules Home Page

- A test can be prepared to analyze the educable mentally retarded children at the end of each module.
- Prepared modules can be shown to educable mentally retarded children (Figure 3).

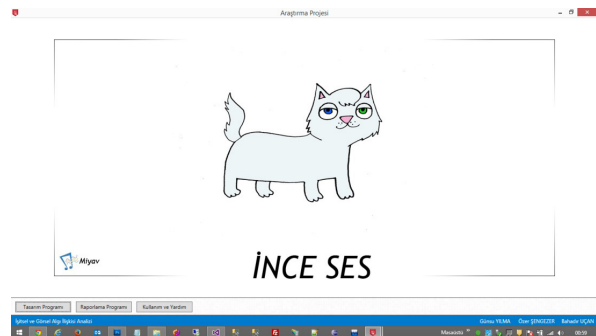


Figure 3. Visual and Audio Presentation Module (Sample Module 1/Cat)

- Applying the prepared tests on educable mentally retarded children (Figure 4).



Figure 4. Module Test Screen



- Each module and test can be of multiple implementation
- It can preserve the personal details about educable mentally retarded children.
- It can perform an analyzed data with all input parameters (Figure 5).

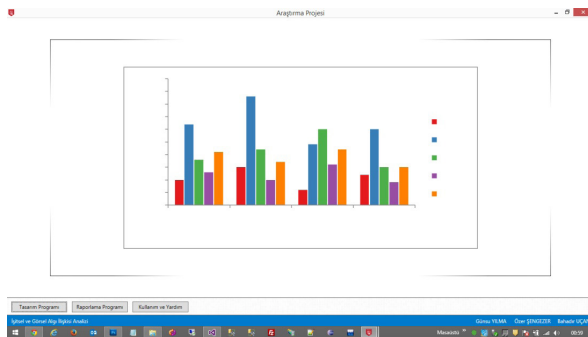


Figure 5. Analysis of Modules

## 5. Conclusion and Suggestions

Studies to examine the level of ability to associate the visual elements with educable mentally retarded children's auditory perception contribute significantly to the development of their auditory and visual perception. The image of which sound is heard can place longer in the memory of educable mentally retarded children through sounds heard. Vocal and visual stimuli can provide convenience to their lives. For example, to teach tap image through tap sound may help the use of tap at home.

Such studies carried out can also improve the matching skills of educable mentally retarded children. It can be presented as a kind of educational- tutorial game material with a variety of matching games.

Environmental sensitivity, as in every child, is a vital condition for educable mentally retarded children. Recognizing things around us associating with sounds plays a more important role in memory and makes it easier

to learn, recognize anything. Therefore, things known are approached differently. Thus, educable mentally retarded children around may be more sensitive individuals who can recognize the environment, and they can develop social harmony skills with such studies.

Such study created digitally, in terms of ease of use, makes the educable mentally retarded children's education easier. Modules designed for special education teachers as a digital training material can also be used in special education. The courses can be more effective and fun. They can make differences in their lives.

## REFERENCES

- [1] Barry, P. 2010. *Basics Animation 04: Stop-Motion*. Switzerland: AVA Publishing. ISBN: 2-94-037373-6
- [2] Doyle, Al. 2001. "Web Animation : Learning in Motion", *Technology & Learning*. Sep. Vol. 22, Issue 2
- [3] <https://www.questia.com/magazine/1G1-79053214/web-animation-learning-in-motion>
- [4] Guinness World Records, [10.04.2015] <http://www.guinnessworldrecords.com/records-3000/first-animated-film>
- [5] Kahraman, A.D. 2013. "Canlandirmanin (Animasyonun) Öğrenci Basarilarina ve Derse Iliskin Tutumlarina Etkisi", PhD Thesis. Gazi University Educational Sciences Institute. Ankara / Turkey
- [6] Luckasson, R., Borthwick-Duffy, S., Buntix, W.H.E., Coulter, D.I.,

- Chaig, E.M., Reeve, A. et al.2007.  
*Mental Retardation: Definition, Classification and System of Supports.*  
Tenth Ed. Washington, DC : American Association on Mental Retardation
- [7] Sandrew Barry B., Hamby D., 1990.  
*Computergraphic Animation System.*  
<http://www.google.com/patents/US5252953> [10.04.2015]
- [8] Taylor, Richard, 1996. *The Encyclopedia of Animation Techniques.* Philadelphia : Running Press. ISBN: 0-78-581805-7
- [9] Wellman, D. 2011. *jQuery 1.4 Animation Techniques: Beginners Guide,* Birmingham: Packt Publishing. ISBN:1-84-951331-7
- [10] Werts, M., G., Culatta, R., A., Tompkins, J., R. 2007. *Fundamentals of Special Education. What Every Teacher Needs to Know.* Third Ed. Ohio: Pearson Merril Prentice Hall. ISBN: 0-13-171491-0
- [11] Whitehead, Mark. 2012. *Animasyon Filmler.* Translated and edited by Aziz Turuskan, Istanbul: Kalkedon Yayincilik
- [12] Yildiz, M. 2005. “Animasyon Amacli Kukla”. Master Thesis. Hacettepe University Social Sciences Institute. Ankara/Turkey
- [13] Yilma, G. 2010. “Egitilebilir Zihinsel Engelli Cocuklarda Muziksel Alginin Olculmesi ve Degerlendirilmesi”. Master Thesis. Inonu University Social Sciences Institute. Malatya/ Turkey