

Hearing Aids Maintenance Training for Hearing-Impaired Preschool Children with the Help of Motion Graphic Tools

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Abstract—The purpose of the present study was to investigate the effectiveness of using motion graphics as a learning medium on training hearing aids maintenance skills to hearing-impaired children. The statistical population of this study consisted of all children with hearing loss in Ahvaz city, at age 4 to 7 years old. As the sample, 60, whom were selected by multistage random sampling, were randomly assigned to two groups; experimental (30 children) and control (30 children) groups. The research method was experimental and the design was pretest-posttest with the control group. The intervention consisted of a 2-minute motion graphics clip to train hearing aids maintenance skills. Data were collected using a 9-question researcher-made questionnaire. The data were analyzed by using one-way analysis of covariance. Results showed that the training of hearing aids maintenance skills with motion graphics was significantly effective for those children. The results of this study can be used by educators, teachers, professionals, and parents to train children with disabilities or normal students.

Keywords—Hearing-impaired children, hearing aids, hearing aids maintenance skill, and motion graphics.

I. INTRODUCTION

HEARING-IMPAIRED children are deprived of many environmental experiences. However, the purely acoustic aspects of listening are very limited compared to their role as a communicative way of conveying a speech message; a world of words that connects individuals, families and community members together [1]. Hearing impairment consists of two types: deafness and hard of hearing. The term deafness is used when the child is unable to hear and understand sounds even by using assistive hearing devices (such as hearing aids). In contrast, hard of hearing is a condition that the child typically has difficulty in hearing (compared to normal children) but is able to hear and understand sounds by using assistive hearing devices [2]. Hearing impairment has many negative consequences for the children if they are not supported by

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educational and therapeutic actions. These children are at increased risk of being deprived of various environmental and communication experiences and this can cause many disadvantages. The first harmful consequence of hearing loss is severe slowdown or delay in the development of the child's speech language. Another disadvantage that comes from these language disorders in hearing-impaired children is their cognitive function problems in areas such as weakness in hearing perception, auditory memory, and finally weakness in internal thinking and reasoning [3]. The following are some of the most important negative consequences of hearing loss that can greatly damage the personal and social aspects of a child's life:

- Delay in language development
- Failure in cognitive development
- Behavioral and psychological problems
- Social adjustment disorder
- Academic failure

Unfortunately, hearing-impaired children, due to their inability to process auditory information, are deprived of much of the training, especially formal education, thus, if they do not use special education and rehabilitation equipment, their learning and thinking is also to some degree restricted [4].

One of the most useful assistive tools to help children with hearing loss is hearing aids. Hearing aids are advanced electronic devices that directly affect the communication and relationship of a hearing-impaired person with others (family, co-workers, and friends) as well as with the effective surrounding environment [5]. Specialists always recommend people with hearing loss to wear hearing aids during the day. Since hearing aids are electronic, sensitive and complex devices, proper use and effective maintenance of them require careful consideration. These result in increasing the efficiency and life of these devices. Therefore, the proper use and maintenance skill of hearing aids need to be trained to hearing-impaired children by specialists (typically audiologists, speech therapists, and special education educators). In order to take care of hearing aids, the following need to be considered:

- How to clean hearing aids
- How and when to replace the hearing aids' battery
- How to keep hearing aids away from any harm (water, moisture, direct sunlight, heat sources and radiation)
- How and when to use hearing aids

Experts are constantly trying to help hearing-impaired children by inventing new methods, techniques and

equipment. Since 1990s, TVs produced in the United States have been equipped with subtitle chips so that viewers could watch the TV programs with subtitles. TV subtitles allow hearing-impaired people to understand film's content. These subtitles help hearing-impaired people become aware of social issues of the day. So, the subtitles can be used as a tools for educational or entertainment purposes [6].

Today many other assistive technologies are invented which can be used by hearing-impaired people:

- Assistive listening devices (ALDs): they help to amplify sounds, especially in cases where there is a lot of background noise.
- Augmentative and alternative communication (AAC): These devices can synthesize speech from text.
- Alerting devices: which produce a loud sound or blinking light to let someone with hearing loss know an event is happening.

By the development of educational technologies and software, the use of electronic contents are becoming more prevalent in teaching children with disabilities, especially hearing-impaired children (due to their healthy sense of sight). These tools play an important role in the visual representation of much of the content needed by hearing-impaired students. There is also some software for deaf students that can be used to enhance their reading and writing skills [7].

Researchers always try to study the effectiveness of using the electronic contents in teaching different concepts to hearing-impaired students. Bazrafshan et al. conducted a study to investigate the effect of training science by using electronic content on the learning of hearing-impaired students. They chose 30 deaf students at the 6th grade studying in special schools in Tehran by using a multi-stage cluster sampling method and divided them into two groups of experimental and control groups. After performing a pre-test on both groups, the experimental group was taught by using some e-content materials in 24 sessions, but the control group was trained according to typical teaching. Analyzed data from pre-test and post-test by analysis of covariance showed that e-contents had been effective in improving the learning of science for students with hearing loss [8]. In another study, Kiyarsi investigated the effect of teaching sciences using animation, dynamic and static images on the academic progress of students. The sample of research consisted of 77 female students studying in 5th grade in Dezful city that were chosen by using a multi-stage cluster sampling method. Subjects were randomly assigned to three experimental groups (25 students in a group learning by animation, 26 students in a group learning by dynamic image and 26 students in a group learning by static image). All three experimental groups received different education for 12 sessions by different tools. The data were collected using a researcher-made educational achievement test. Data from the achievement test were analyzed through one-way analysis of variance and post-hoc Bonferroni test. The results of data analysis indicated that teaching method based on animation technique was more effective than methods based on dynamic and static images [9].

In addition to the use of educational videos, animations, etc. as educational e-contents, another new and low-cost tool that can be effective in teaching essential skills to hearing-impaired children is motion graphics. Motion graphics literally consist of two words "motion" and "graphics", in which graphics refers to images such as vector images that are generally created by graphic software such as Adobe Photoshop, Adobe Illustrator and etc. The term motion graphic was first coined by Whitney in the multimedia world. "Motion graphics is defined as the transferring static elements like graphics, images, texts, and logos into moving designs by adding another dimension: time. In motion graphics, all elements; colors, shapes, movements, sound, typography appear to be in harmony. Every detail is loaded with meaning to support a message" [10]. The first consideration in motion graphics is the power of movement. "Motion is the strongest appeal to attention" [11]. So, this feature of motion graphics can easily attract learners' attention to the main concept which it is intended to convey. Motion graphics are used in the production of advertising teaser, two-dimensional animations, educational media and etc. No need for camera, light, and actor and also the use of attractive colors, varied graphics and the creation of interesting effects, are all the reasons why motion graphics is one of the most popular tools, especially for advertising at the present time. By considering the benefits of this tool consisting; its low cost and attractions, the present study seeks to answer the question of whether or not hearing aids maintenance skills and proper use can be effectively taught to hearing-impaired children by using motion graphics. Therefore, the purpose of the present study was to investigate "the effectiveness of training maintenance skills and proper use of hearing aids on learning of preschool hearing-impaired children with the help of motion graphics tools". So the research hypothesis is as follows: The use of motion graphics technology is effective in training proper use and maintenance skills of hearing aids for preschool hearing aids children.

II. METHOD

The research method was experimental and its design was pre-test and post-test with the control group. At first, both experimental and control groups received pre-test and after the intervention in the experimental group, the post-test was performed in both groups again.

A. Population, Sample and Sampling Method

The statistical population of this study included all children with hearing loss in the 4 to 7-year age range in Ahvaz. Using a multistage random sampling method, 60 individuals were selected and randomly divided into control and experimental groups (30 children in each group). In order to select the sample, two urban districts (district 2 and district 3) were selected from the four districts of Ahvaz city. In each of these areas, a special school for the hearing-impaired student was selected. Then 30 children with hearing impairment in the 4 to 7-years age range were randomly selected from each school to participate in the study. It is to say that these students were chosen after their parental consent.

B. Instrument

In order to measure hearing aid maintenance skills for hearing-impaired students, the researcher in collaboration with experienced special educators of hearing-impaired students, some speech and hearing specialists, as well as parents of hearing-impaired students, developed a tool for this purpose. Subsequently, its validity was reviewed by a number of experts. Some of the questions were removed, and some were added or edited. Finally, the questions were reviewed and approved by several other experts related to the field of hearing loss. The reliability of the questionnaire was calculated at 0.60 using Cronbach's alpha method. The questionnaire has nine questions that the parents of the children responded to the questions using a 5-point Likert scale (score 1 to 5) with a minimum and maximum score of 9 to 45. The questions of the questionnaire cover the following domains:

- Using hearing aids throughout the day constantly
- Removing hearing aids before bathing, sleeping, hair drying and using hair spray
- Drying the ears after bathing
- Using a holder to prevent hearing aids from dropping
- Turning off the hearing aid when they are not used
- Keeping hearing aids in the suitable place

C. Intervention Description

The intervention consisted of training using a 2-minute motion graphics clip with dynamic images and without any speech sound. This clip demonstrated the proper methods of using and maintaining hearing aids. The character used in this clip was a boy who was designed for the first age group (group A according to the classification proposed by the Institute for the Intellectual Development of Children and Young Adults of Iran) by using Adobe Illustrator software. In this clip, the color palette is based on a brand-name archetype called Arka, and is selected based on the theme of the Arketype project, which is blue, yellow, white and red. Finally, all elements of the clip were animated using After Effects software.

III. RESULTS

TABLE I
DESCRIPTIVE STATISTICS REGARDING THE HEARING AID MAINTENANCE SKILLS OF THE CHILDREN IN THE PRE-TEST AND POST-TEST

Descriptive Statistical		Mean	Standard Deviation	Min Score	Max score
Experimental Group	Pre-test	16.43	4.57	10	30
	Post-test	24.60	4.90	13	37
Control Group	Pre-test	16.63	3.24	12	26
	Post-test	17.90	3.47	13	28

As Table I shows, the mean and standard deviation of the scores of the control group in the maintenance skill of hearing aids variable were 16.63 and 3.24 in the pre-test and 17.90 and 3.47 in the post-test, respectively. Also, the mean and standard deviation of the scores of the experimental group in the maintenance skill of hearing aids variable were 16.43 and 4.57 in the pre-test and 24.60 and 4.90 in the post-test, respectively.

In order to find out whether these difference scores were accidentally or by intervention, one-way analysis of covariance was used.

After examining the assumptions of covariance analysis and also the compliance of collected data with these assumptions (data normality, linearity, variance equality, homogeneity of variance-covariance matrices, and homogeneity of regression slope), the hypothesis of the present study (the use of motion graphics technology is effective in training proper use and maintenance skills of hearing aids for preschool hearing aids children.) was tested at a significant level ($\alpha = 0.05$).

TABLE II
RESULTS OF ONE-WAY COVARIANCE ANALYSIS TO EVALUATE THE EFFECTIVENESS OF USING MOTION GRAPHICS TECHNOLOGY IN THE TRAINING OF MAINTENANCE SKILLS AND PROPER USE OF HEARING AIDS OF HEARING-IMPAIRED CHILDREN

Source	Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Fixed Value	82.10	1	82.10	19.03	<0.0001	0.99
Pre-test	746.17	1	746.17	172.98	<0.0001	1
Group	55.91	1	55.91	12.96	0.001	0.94

According to Table II, by controlling pre-test scores, the significance level (0.001) indicated a significant difference between the experimental and control groups' scores in the proper use and maintenance skills of hearing aids. Therefore, the hypothesis of the present study was accepted. The values of F and test power for all tests were 12.96 and 0.94, respectively. It should be noted that there is a significant difference between the pre-tests of the two groups ($F = 172.98$ and $P < 0.0001$). According to the pre-test differences between two groups, it was needed to run a pre-test, and it was done correctly. Fig. 1 shows the mean scores of the variable and their changes in two stages for two groups.

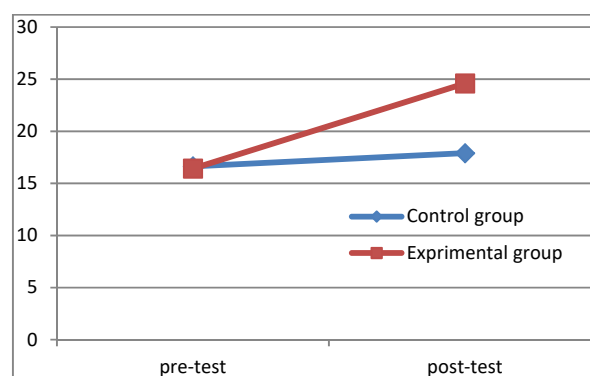


Fig. 1 Mean of experimental and control groups in maintenance skill and proper use of hearing aids in pre-test and post-test

IV. DISCUSSION AND CONCLUSION

The findings of the study showed that using motion graphics clip was effective in training hearing aids maintenance and proper use skills. This training significantly improved these skills in the experimental group compared to the control group ($F = 12.96$ and $P < 0.001$). In order to explain these findings, it can be said that motion graphics, as

one of the new tools, make learning more attractive to the audience. Although motion graphics have so far been used extensively in the delivery of promotional messages, but this tool also can multiply the attractiveness of educational concepts and messages to ease transferring the required messages to the audience. Apart from the attractiveness and motivation that motion graphics made in the learners, and consequently enhancing efficiency of learning, it also saves time during the process of conveying the intended message to the learners. This tool can transfer many concepts in a very short time (as in the present study, a 2-minute clip was used to teach the skills of maintenance and proper use of hearing aids). Also, a message made with the motion graphics tool can be repeated over and over or applied to different groups and individuals without the need for extra cost. So, one of the reasons for the effectiveness of motion graphics on learning is its visual appeal to learners, especially those at early ages (in the present study, children from 4 to 7 years old). According to Piaget's developmental psychology, children at this age are at the pre-operative stage [12], so by lack of verbal language development and abstract thinking, the use of tangible tools is more effective in their learning. Therefore, since motion graphics can transfer messages tangibly and simply, it is easier and more effective for audiences of this age to understand the messages behind it.

Another point that can be said in explaining the effect of motion graphics on hearing aids maintenance skill in these children is related to their specific characteristics or in other words, the type of their disability. In this regard, hearing-impaired children due to lack of verbal skills which results in failure to understand messages that are verbal in nature, need tools such as motion graphics much more than normal children. Because the main emphasis in training by this method is to use the visual sense without the need of delivering verbal messages (compared to other tools like animation). Another reason for the effectiveness of training hearing aids maintenance skills for these children may be due to the type of disability (hearing-impaired children).

In general, it can be said that the effectiveness of training hearing aids maintenance skills by using motion graphics in this study relates to the following factors:

- 1) Its visual appeal and motivating the learner or the audience to learn new concepts.
- 2) Compliance with the age range of the target audience. Because they did not reach normal verbal growth and abstract thinking, so it is easier and clearer to understand these messages through motion graphics.
- 3) The hearing disability of these children, and deprivation of auditory messages.

V. SUGGESTED RESEARCH

It should be noted that in generalizing the results of this study to other ages or cultural groups, geographical areas and normal children or other children with other disabilities should be thought. It is also suggested that due to the attractiveness and accessibility of smartphones, further research on mobile video broadcasting and its effectiveness on other essential

skills can be investigated. In addition, it is needed to produce a variety of clips to teach other essential skills to this group of children or teach these skills to other children with other disabilities.

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