Eurasia Journal of Mathematics, Science & Technology Education, 2016, **12**(1), 109-124

The Effectiveness and Usability of the Educational Software on Concept Education for Young Children with Impaired Hearing

Hanife Goker, Latife Ozaydin & Hakan Tekedere
Gazi University, TURKEY

•*Received 16 April 2015*• *Accepted 28 July 2015* • *Published online 18 Oct 2015*

Early intervention and early education have a special place in educating the children with Impaired Hearing (IH). The advancements in information and communication technologies have led to adopting the view that such technologies could be applied in the educational process of the children with IH. Besides, the positive results acquired in the studies conducted in the light of this review have brought up the fact that proper technology-based educational environments should be provided and popularized for the young children with IH. In this study, educational software has been developed for the purpose of teaching emotions and opposite concepts to young children with IH. With this software, videos with topic descriptions, games reinforcing funny and topic-based learning, questions and audio-visual feedbacks have been used. The effectiveness of this software in concept education along with its usability by children has been examined; and in addition, the subjective viewpoints of the teachers of students with IH on this software have been consulted as well.

Keywords: educational software, hearing impairment, concept teaching, usability, young children

INTRODUCTION

Human brain, starting from birth till the age of five, develops far more quickly when compared to the other stages of life. Preschool years are the times when the brain starts to take its efficiency to the utmost level by deciding on what connections will be maintained or which ones must be left out (Blackman, 2002; Shonkoff & Phillips, 2000). Starting from the very first years of life onwards, all the stimulants - either verbal or non-verbal - which reach the infant from the outer world can be said to create learning opportunities. Once the infant is able to make sense out of these data acquired through the sensory organs and use them, the learning process starts to take place. However, these processes become harder and take longer time as far as children with developmental delays or disabilities are concerned (Guralnick,

Correspondence: Hakan Tekedere,
Vocational High School of Health Services, Gazi University, 06830, Gölbaşı, Ankara, Turkey.
E-mail: tekedere@gazi.edu.tr
doi: 10.12973/eurasia.2016.1207a

ISSN: 1305-8223

2010).

Tüfekçioğlu (1998) emphasized that children learnt a great deal of information through their sense of hearing by starting from their birth, and also drew the attention to the power of auditory senses in rapidly and easily acquiring complex skills like native language and speech until the primary school years. Within this context, it is observed that the hearing losses that occur innately or in the first years of children's lives cause significant retardations in both their receptive and expressive language developments. This disability affecting primarily the language development of the children with hearing-impairment is known to cause them to fall behind their peers by negatively affecting their other areas of development as well as their academic skills (Cunningham & Cox, 2003). For this reason, the children suffering from hearing impairment in the first years of their lives, which is a critical time for learning and all the areas of development, should be allowed to benefit from early-period opportunities as much as possible by getting assisted by early diagnosis (Turan, Küçüköncü, Cankuvvet, & Yolal, 2012), early instrumentation, early cochlear implant (Karasu, Girgin, & Gürgür, 2015) as well as a rich environment and family education by the stimulants. Among the early diagnosis and early intervention programs in question are also the skills of readiness for school, such as concept education and the education of proper communicative skills for the children with hearing impairment (Carlton & Winsler, 1999).

Carlton and Winsler (1999) defined the process of readiness for school as the flexible adaptation of both school and children to one another by evaluating this process within the framework of developmental approaches. On the other hand, the skills of readiness for school are observed to be listed as receptive and expressive language skills, early reading, attention, mathematics and conceptual skills (Bracken & Crawford, 2010; Harrington, DesJardin, & Shea, 2009). Each of these skills is of great significance for the future school years of hearing-impaired children. Besides, it is emphasized that among these skills, the hearing-impaired children learn the skills like starting communication with their peers showing normal development, problem solving, and expressing emotions. And when they participate in the classes of general education, they will have the chance to benefit from the inclusive educational practices (Harrington et al., 2009; Dyck, Farrugia, Shochet, & Holmes-Brown, 2004; Richels, Bobzien, Raver, Schwartz, Hester, & Reed, 2014), and thus, benefit from the peer-to-peer interaction (Fabes, Hanish, & Martin, 2003; McGaha & Farran, 2001; Odom & Strain, 1984).

State of the literature

- Early intervention and early education, as in all children who need special care, are important for the hearing-impaired children. It is known that the cognitive and social skills of hearing-impaired children with no early educational support regress along with their communicative skills.
- The educational software prepared for the hearing-impaired children in Turkey are considered as being applicable to the school-age children in general. There are limited numbers of educational software prepared for the young children with IH.
- It is also known that the educational software are effective in the education of cognitive, linguistic and academic skills for the young children with IH, and make it possible for the students to keep the information learned. Thus, they contribute to the children's levels of readiness for school at the proper time.

Contribution of this paper to the literature

- In this study, an educational software has been developed for young children with IH for the purpose of concept teaching; and software effectiveness, its usability by children and its social validity level by the teachers of the children with IH have been analyzed.
- Educational software provided a unique contribution to children's learning by the use of appropriate colors and interface, video-assisted topic descriptions, reinforcement of the subjects with questions, and entertainment through the games provided along with the audio-visual feedbacks given.
- The issue of the educational software prepared being efficient/effective in teaching emotions and contrast concepts to 5 young children with limited information in these skills was tested by using the AB model, which is one of the single subject research models. It was seen that the permanency of the concepts learned had been maintained even in the 2nd and 3rd weeks after the practices were completed.

On the other hand, it is known that when they start school by learning a number of basic concepts, such as numbers, letters, colors, shapes, emotions, abstract concepts and contrast-similar concepts, their possibility to be able to be accepted socially both by their teachers and their peers, and their academic success will also increase (Richels et al., 2014; Harrington et al., 2009). In addition, Stevenson and Newman (1986) drew the attention to the importance of the subject by highlighting that children's success in academic tests was associated with their learning basic concepts like recognizing the letters and numbers they had acquired in the early period.

We see that the pursuits as to the qualified teaching methods to be used in the education of the basic concepts as well as teaching these concepts to the hearing-impaired children at an early age are on the increase. It is seen that Easterbrooks and Stephenson (2006), after reviewing relevant articles in the literature, reported that 20 methods in reading, mathematics and science education were effective and evidence-based practices for hearing-impaired or deaf children. Of those 20 methods which were evidence-based, the use of technologies were determined to have been more effective in math and science education when compared to the education of reading skills. In another study, Easterbrooks and Stephenson (2012) emphasized that the evidence-based practices could not be so effective in enhancing children's motivations in reading comprehension studies, which, therefore, prevented them from having an efficient learning. Such pursuits are observed to have made it imperative for learning and teaching methods to be revised and brought together with modern technologies. In parallel to the developing technology, the computer-based practices used today have a widespread area of usage, such as the Internet, Communication Technologies, CD-ROM-based materials and multimedia presentation tools (Hasselbring & Williams Glaser, 2000).

The area of use of the computer-based practices are observed to become increasingly popular since they shorten the learning periods of children, increase their motivations, support their individual learning processes and increase the permanency and generalizability of the information learned. Another situation promoting the use of computers in education is considered to result from preferring it because of its game-based practices. It follows that a game-based learning environment supports the children's individual learning speeds, minimizes their anxiety and worry levels, and makes the learning process much more enjoyable (Bayırtepe & Tüzün, 2007).

Today, it is observed that the computer-assisted educational systems used in teaching communicative and academic skills to the hearing-impaired children are among the evidence-based practices (Ferrell, Bruce, & Lucner, 2014), and that they gain more and more significance with each passing day. It was determined through computer-assisted educational systems that hearing-impaired children are provided with maths teaching (Cannon, Fredrick, & Easterbrooks, 2010), grammar teaching (Cannon, Easterbrooks, Gagne, & Beal-Alvarez, 2011), sound-letter acquisition (Beal- Alvarez, Lederberg, & Easterbrooks, 2011), and reading and language acquisition (Easterbrooks, 2010). Although computer-assisted educational systems prepared for the hearing-impaired children in the international literature are rapidly becoming popular, there are still limited number of studies conducted on the hearing-impaired children in our country. In the studies dealing with the computer-based practices prepared for the hearing-impaired individuals in our country, webpage designs (Çakır, Çetin, & Baş, 2013), the design of the computer-assisted written expression skills, their practice and evaluation (Çiftçi, 2009), and web-based educational environments (Çal, 2011) were included. It is understood that the only study to be performed on the preschool hearing-impaired children was conducted by Sevinç (1996). In this study, where the efficacy of the practices provided through

the use of computer-assisted education and the involved instructors was compared in teaching contrast concepts to the children with intense hearing impairment, Sevinç (1996) determined that children learned a larger number of contrast concepts in a considerably shorter time with the help of a computer-assisted educational program.

In line with the literature summarized above, this study is considered to be unique contribution for the sake of the first Turkish educational software in our educational system for the purpose of teaching concepts to the young children with IH. In addition the program prepared within this study is thought to contribute quite a great deal to the national and international literature due to the fact that it creates the opportunity to evaluate the efficiency and maintenance through a single subject research method that takes into consideration the individual characteristics of the subjects (Tekin & Kırcaali-İftar, 2006).

In order to teach the concepts (those involving emotions and opposite concepts) to young children with IH through this concept, an educational software in accordance with the curriculum of The Ministry of National Education, Preschool Educational Program (MoNE, 2013) was developed, and the answers to the following questions were sought in line with this: (i) Is the educational software that has been prepared enabled to make the participants learn opposite concepts and emotions? (ii) Can the participants maintain the concepts learned even during the maintenance sessions? (iii) Is the usability level of the educational software prepared in such a style that is appropriate for young children with IH in terms of their capabilities? (iv) Is the prepared software appropriate for young children with IH according to the subjective evaluations of the instructors of the hearing-impaired children?

METHOD

Participants

The participants of the study consisted of 4 female children and 1 male child whose ages varied between 4 and 7, and who received assistive educational service in a private education and rehabilitation center in Ankara in line with the program arranged for the hearing-impaired. All the participants had cochlear implants. However, it was determined that all of them received implantations in the late period (at the age of 3 being the earliest). The participants were 5 children a) who had no knowledge of the concepts used in the study (opposite concepts and emotions), b) who were capable of using computers at the level of "computer literacy", c) whose hearing losses varied between 45%-70%, and d) from whose parents an informed consent for their participation was received in line with the views of the instructors of the Impaired Hearing who were in charge of the institution.

Ali is 7 years and 4 months old. He is diagnosed with 48% severe sensorineural hearing loss. He attends the 1st class in the school of hearing-impaired children. The group teacher observed that Ali did not know even the simplest concepts due to the delay in his implantation. The hearing loss that was already innate was realized only after 10 months. His father or mother has no hearing loss problems. Among the educational programs necessary to be taken in his file were the subjects involving language, mathematics, social communication and reading, writing and comprehension.

Rana is 5 years and 10 months old. Although she is innately a hearing-impaired child, it is observed that she was only diagnosed when she was 9 months old. Her hearing loss rate is 47%. There is total hearing loss in her right ear, whereas she has severe sensorineural hearing loss in her left ear. She was instrumented 2 years ago.

Her father or mother has no problem with hearing impairment. The necessary educational subjects to be provided for her were determined as language learning, hearing training and social communication skills. She attends the inclusive education in the preschool educational program.

Elif is 5 years and 9 months old. Her hearing loss is 68%, and she is also diagnosed with speech block. Within her family circle, her mother has a hearing impairment. For this reason, she is observed as preferring the sign language in her communications. She does not attend the preschool education. In her file, the necessary educational subjects she needs to take are language learning, social communication skills and hearing training.

Ayşe is 5 years and 5 months old with 52% hearing loss. Language learning, hearing training and social communication skills are the subjects she needs to take in her educational program. Her family has no hearing loss problems.

Serra is 4 years and 9 months old, with 52% sensorineural hearing loss. Her family has no hearing loss problems. Among the subjects she needs to take are maths, language, social communication skills and hearing training.

The demographic characteristics of the participants are given in Table 1. The names of the children who participated in the research were changed.

Setting

The research was carried out in a private education and rehabilitation center in Ankara where an assistive educational program prepared for the individuals with Impaired Hearing is practiced and where the young children with IH attend. Each session was performed in a classroom equipped with a laptop in which an educational software was downloaded, and a mouse and a speaker arranged in the form of one-to-one teaching session for the subjects between the hours 13.00-15.00.

Independent variable

The independent variable (IV) of the research is an educational software prepared for the purpose of teaching the concepts expressing emotions and contrasts to the participants.

The developed educational software consists of 4 main sections as Lessons, Questions, Videos and Games. The numbers, colors, emotions and opposite concepts planned to be taught within the context of the software are explained by means of a verbal lecture and also a sign language. In the preparation of the software, the following criteria were taken into consideration: the selection of colors was performed in a way that would apply to the children involved, frequent use of visual materials, the audio content as a whole, both audio and visual feedbacks, the use of simple single menu structure, menu labels as well as their visual ones, a small number of menus, the period of giving feedback, the appropriateness of the colors

Table 1. The characteristics of the participants

Subject	Gender	Age	Hearing loss condition within the Family	The Rate of Hearing Loss	The Age of Receiving Cochlear Implant	The Periods of School Attendance
Ali	Male	7 years, 4 months	None	48%	6	2
Rana	Female	5 years, 10 months	None	47%	4	1
Elif	Female	5 years, 9 months	Yes, Mother	68%	3	2
Ayşe	Female	5 years, 5 months	None	52%	2	2
Serra	Female	4 years 9 months	None	52%	2	1

used for the target population, and also easy-to-use quality of the software.

Also in similar studies, it is emphasized that in the preparation of educational software or web pages, the criteria such as the number of menus (Shneiderman, 1997), the period of response (Polkosky & Lewis, 2002), the appropriateness of the colors used (Shneiderman, 1997), its consistency and easiness of its use (Nelsen, 1999) increase the usability of the software. While the subjects were being briefed on the process, the audio expressions were supported by the descriptions through the sign language, as well. The concepts taught were supported by the visual tools to attract the attention and arouse an interest among the young children, and questions and games were also included to reinforce the subjects in an applicable way for the children's level.

Figure 1 demonstrates (Scenes 1, 2, 3 and 4) some of the examples of the interfaces regarding the education of emotions and opposite concepts included in the Lessons Section.

Dependent variable

The dependent variable of the research is participants' learning the concepts and expressing emotions and opposites taught in line with the educational software. 13 assessment questions were prepared for the purpose of checking whether or not the participants had learned the concepts taught. It was observed in all the stages of the study that the participants had exhibited 2 types of responses, which were the behavior of clicking the true answer, and the behavior of clicking the false answer to the assessment question. The true answer was defined as a) the participant's listening to the assessment question and reaching the audio-visual feedback, "True", by clicking the true answer. The false answer, on the other hand, was defined as b) the participant's listening to the assessment question and reaching the audio-visual feedback, "False", by clicking the wrong answer. During the educational sessions, error corrections were performed for the wrong answers of the participants related to both opposite concepts and to those expressing emotions. In order to maintain the interaction, the participants were made to perform the right behavior by providing them with verbal prompts and physical assistance.

Experimental design

A single subject research model referred to as the AB Model was used for the purpose of determining whether or not the educational software prepared for the

Figure 1. Examples of software interfaces

conceptual education of young children with IH was effective in allowing them to learn the concepts expressing contrasts and emotions. The first level of this model is known as the baseline level. The baseline level is referred to as "A." This is the period in which no intervention is applied to the young children with IH. The second period, on the other hand, is the intervention phase in which the independent variable is applied and where its effect on the dependent variable is observed. This phase when the intervention is applied to the young children with IH is referred to as "B". The experimental control of the research was ensured by practicing the independent variable, in other words, by allowing the expected change to take place in the dependent variables (the concepts expressing contrasts and emotions) through practicing the prepared software (Tekin-İftar & Kırcaali-İftar, 2006).

Experimental process

Baseline level

At this stage, by presenting the target stimulant "Now we are going to learn opposite concepts", to the participants without performing any teaching, the participants were asked to hold the mouse and follow the audio-visual stimulants. The true and the wrong answers given by the participants to the assessment questions in the wake of presenting the target stimulant were observed. Baseline level data were collected until obtaining three stable data points consecutively for each participant.

Training sessions

A three -consecutive session- teaching was performed during the teaching sessions for the concepts expressing each contrast and emotion as the first stage of the educational software. Usage of software was taught to children by modeling. Modeling was performed in three stages: a) Researcher becomes a model by using all steps of the software; b) By giving an opportunity to the child to try; c) The child is allowed to follow the software by three feedbacks. Correct responses were reinforced by saying 'well-done, good on you', etc.

Intervention sessions

At this stage, the participants were asked to use the educational software by providing them with the target stimulant, "Now it is your turn". After providing the target stimulant, the participant was encouraged with a verbal expression, "You can do it, etc.", unless s/he even started to use the educational software. During the practice stage, this stage was ended only when an increasing data drift occurred in the wake of three consecutive sessions with all the participants or when a performance at least over 20% of the average of the starting level was exhibited. Observing a performance of at least over 20% of the starting level in the educational practices was regarded as a criterion for ending the practice stage (Laushey, Heflin, Shippen, Alberto, & Fredrick, 2009). Four sessions were performed at the practice stage of each participant.

Maintenance sessions (follow up)

The maintenance data were performed as one session each with all the participants in the 2nd and 3rd weeks after the final intervention session. The participants were asked to use the educational software by providing them with the target stimulant, "Come on, let's play our game". During the maintenance stage, the reinforcers were grayed.

Data collection

In this study, the data for effectiveness and reliability were collected. Separately, the social validity of the educational software in question was evaluated by taking into consideration the usability of the software by the participants, and also by receiving the subjective views of the teachers of the hearing-impaired. The data of efficacy; all the right and wrong answers given by the participants with respect to the dependent variables in each session were recorded through the event recording technique. In this direction, the accuracy percentages of each participant as to the concepts expressing both contrast feelings and the emotions were obtained by dividing them by the sum of right and wrong answers and multiplying it by one hundred (Laushey & Heflin, 2000; Laushey et al., 2009). At the stages of the starting level, at least three sessions were arranged for each participant. At the practice stages, however, the consistency of the data was decided on once a performance of at least over 20% of the average of the starting level or an increasing trend the data points were exhibited (Laushey et al., 2009). At least 4 sessions were performed in the practice stage of all the participants. The intervention sessions were ended when two participants (Ayşe and Ali) exhibited increasing trend in the data points in the 4th session, while the increasing data points were reached along with the six consecutive sessions with Elif. Serra and Rana exhibited increasing data points in the five sessions. The maintenance sessions were performed as one session with all the participants in the 2nd and 3rd weeks after the final attendance session.

As for the reliability data; the data over interobserver reliability and application reliability were collected in 30% of all the sessions of the research. Since all the sessions were recorded via the laptop camera, the data over the interobserver reliability were determined along with the number of right and wrong answers of the participants in the sessions as to two dependent variables and by comparing their right and wrong answers recorded simultaneously. The interobserver reliability was calculated through the Agreement/Agreement + Disagreements x 100 formula (Alberto & Troutman, 2009). The interobserver reliability data were calculated as 100% for all the participants. On the other hand, the application reliability data were checked through the "Application Reliability Data Collection Form" prepared for the purpose of determining to what extent these data were in accordance with the practice plan for each participant. The number of the practitioner behaviors recorded in the application reliability data collection form by the observer was divided by the number of the practitioner behaviors planned beforehand, and the obtained result was multiplied by 100, and thus, the application reliability percentage was calculated (Tekin İftar, Kurt, & Çetin, 2011; Tekin & Kırcaali-İftar, 2006). The application reliability data of the study were calculated as 100% for all the participants.

FINDINGS AND DISCUSSION

The accuracy percentages of each participant with respect to the concepts expressing both opposite concepts and emotions in all the stages of the study are shown for Ayşe, Elif, Serra, Rana and Ali in the figures 2, 3, 4, 5 and 6, respectively. In the figures are the baseline levels along with the intervention and maintenance sessions included, and in these sessions, the accuracy percentages of each participant with respect to the concepts expressing both opposite feelings and emotions are shown by means of two different series. The visual analysis suggests that the arranged educational software was effective in allowing all the participants to learn the opposite concepts and emotions easily and that the concepts learned in the 2nd and 3rd weeks after the practice stage had ended as being maintained with their accuracy. The change regarding the learning process of the hearing-impaired

children over the concepts expressing opposite feelings and emotions had taken place during the practice stages after teaching the educational software that was the independent variable of the research. Thus, the fact that there was a functional relationship between teaching the educational software and the independent variable of the research to the participants, and their learning the concepts expressing opposite concepts and emotions was shown through one of the single subject research models referred to as the AB model.

The data over Ayşe's baseline level accurate behavior percentage are seen to be similarly low as those of the others. After having obtained three data points in regard to emotions and opposite concepts at the baseline level, the process was passed on to the intervention level where emotions and opposite concepts were taught. Whereas the sessions' accurate behavior percentage related to emotions and opposite concepts at the baseline level was 44%, it went up to 66,67% like the average of all sessions of the intervention stage. Following the completion of the practice process, a prominent increase in Ayşe's 22,67% value was observed in the data of accurate behavior percentage. In the wake of the intervention stage, the accurate behavior percentage data rose to 96,5% during the maintenance stage, and it was observed to continue with a 29,83% increase according to Ayşe's average intervention level.

The baseline level accurate behavior percentage data of the second target child, Elif, was 35,83%. The accurate behavior percentage data rose up to 70,11% by increasing at an average of 34,28% during the intervention stage. During the maintenance stage, however, the accurate behavior percentage was observed to go up to 97,91% and continued by increasing at a rate of 27,80%.

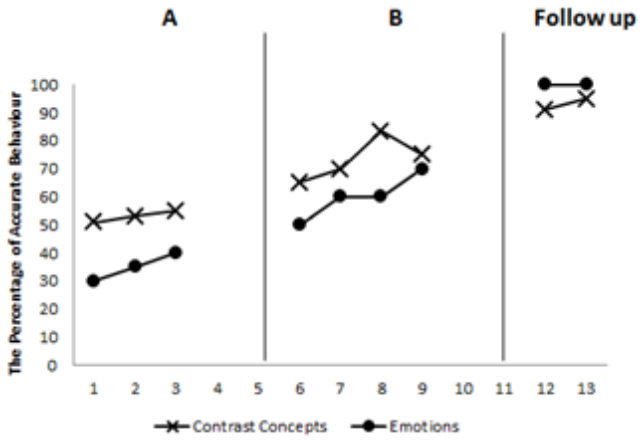

Figure 2. Ayşe's accurate behavior percentages in all the sessions

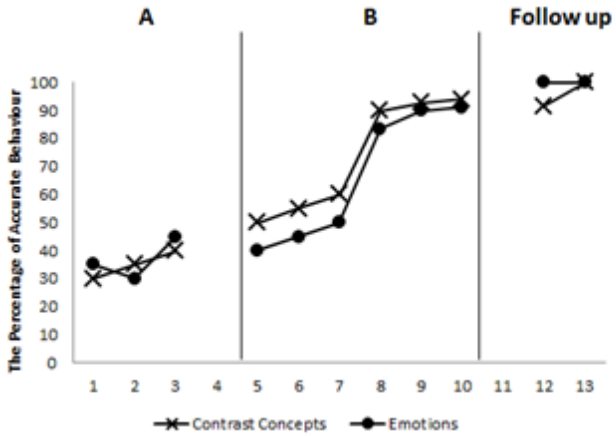

Figure 3. Elif's accurate behavior percentages in all the sessions

Serra's baseline level, as in the other children, was observed to be low (29,75%). The accurate behavior percentage rose to 63,53% by increasing at 33,78% during sessions of the intervention stage. In the maintenance stage, on the other hand, the accurate behavior percentage was observed to continue to increase at a rate of 28,13%.

As seen in Figure 5, Rana's accurate behavior percentage data increased in all the stages. Rana's average of accurate behavior percentage at the baseline level regarding the emotions and opposite concepts was 10,33%, whereas it rose to 38,04% during the intervention stage by increasing at a rate of 27,71%. In the maintenance stage, however, the accurate behavior percentage was observed to continue (86,25%) by increasing at a rate of 48,20%.

Although the fifth target child, Ali's age was older, he did not have any knowledge of emotions and opposite concepts as the other children who participated in the research due to the fact that his instrumentation was delayed. Ali's baseline level accurate behavior percentage is as low as Rana's (20,35%). Yet, during the intervention stage, his accurate behavior percentage was observed to increase at a far more rapid rate (56,66%). In the maintenance stage, this rapid rate was observed to have been maintained by increasing at 97,91%.

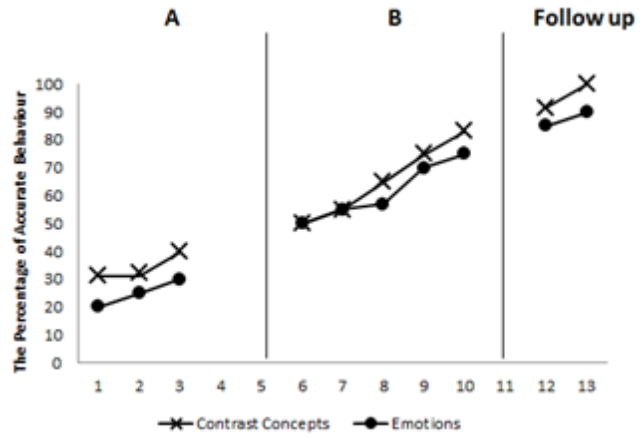

Figure 4. Serra's accurate behavior percentages in all the sessions

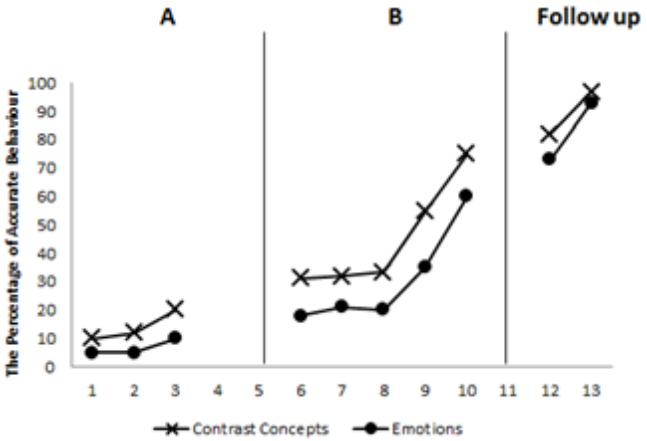

Figure 5. Rana's accurate behavior percentages in all the sessions

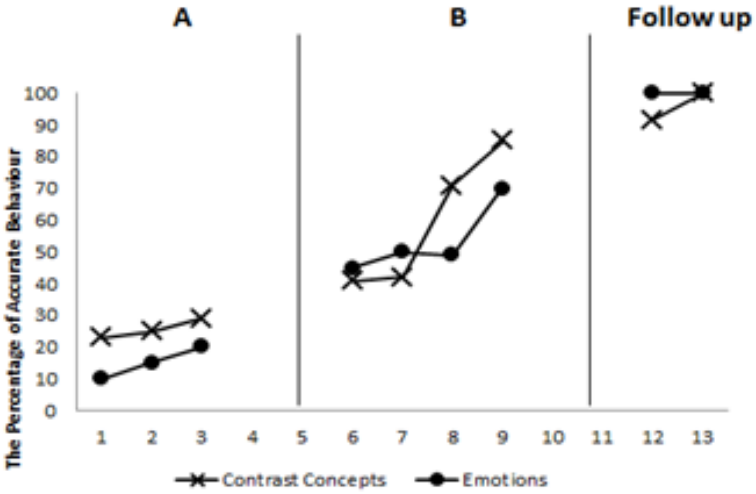

Figure 6. Ali's accurate behavior percentages in all the sessions

Table 2. The social validity scale for the teachers of the hearing-impaired children

Question No.	The Items of the Scale	Average
1.	Are you satisfied with applying this program prepared for the preschool hearing-impaired children?	4,33
2.	Do you think the information technologies are of use to the education of hearing-impaired children?	5
3.	Do you think the use of this educational software developed for the preschool hearing-impaired children contribute to their learning concepts and emotions?	5
4.	Do you think the preschool hearing-impaired children like practising this program?	4,66
5.	Do you think applying this program to the preschool hearing-impaired children is easy?	4
6	Do you think that proper visual tools and content are used within this program for the preschool hearing-impaired children?	4,33
7.	Would you recommend this program to one of your colleagues to use it?	4,66
Total:		4,57

Findings related to social validity

In order to be able to determine the social validity of the educational software developed for the purpose of teaching concepts to the young children with IH, and also receiving the subjective views of their teachers, in other words, to be able to ascertain the education-oriented usability of this software and the satisfaction felt in the wake of its application, a "Social Validity Scale" consisting of 7 questions was prepared in the form of a 5-point likert scale. The scale was filled out by 3 teachers of the hearing-impaired children who were given the opportunity to perform the individual education of the participants and to apply the educational software. The results are given in Table 2. The teachers were observed to have graded the 2nd and 3rd questions of the scale with the highest score (5). However, it was determined that they performed the lowest grading for the 5th question.

The teachers of the hearing-impaired children emphasized with respect to the software that this software was appropriate for individual use, and that its fun aspects at the time of teaching were of great importance since it was an activity in which the children joined with pleasure, and they also added their own positive views as to the software in question.

Findings regarding the usability assessment of the software prepared

The number of clicks and the access time are the two factors playing the key role in determining the property of the use of the educational software or the web sites.

Providing access to information in a short time with a minority of clicks is of importance in terms of demonstrating the efficiency and usability of the system (Uçak & Çakmak, 2009). The tasks to be performed by the users are given below:

Tasks:

1. Find the course description of the concept of old.
2. Find the course description of the concept of hot.
3. Find the course description of the concept of sad.
4. Find the course description of the concept of fear.
5. Find the course description of the concept of large.

The calculations of the average values for the number of clicks and access times performed by the users for each task are given in Table 3.

When the average periods of the times for each task were analyzed in Table 3, the users were observed to have completed the tasks expected within a given period. Task 1 was performed with almost 2 clicks within 9,24 seconds on the average. Task 2 was performed with about one click within 7,88 seconds on the average, which, among all the tasks, is the one performed within the shortest time and with the fewest number of clicks. Task 3 was performed with almost 2 clicks with an average of 14,24 seconds. Task 4 was performed with almost 2 clicks with an average of 14,78 seconds. Task 5, on the other hand, was performed with almost 2 clicks with an average of 14,34 seconds. It is observed that the system through which the tasks can be easily performed by the users is highly applicable. The fact that there are audio-visual expressions next to each menu and in feedbacks in the educational software allows the users to use the system more easily.

It was observed that the educational software developed for the purpose of teaching emotions and opposite concepts to the hearing-impaired children was quite effective along with its high usability, and that the viewpoints of the teachers of the hearing-impaired as to the software in question were quite positive. These findings show parallelism with the efficacy of the computer-assisted educational environments prepared for the hearing-impaired individuals mentioned in the literature.

Çal (2011) put forward the fact that learning became possible for the hearing-impaired individuals through the use of information technologies by allowing them to receive education through watching, applying, and listening at a level they are able to hear, thus, the learning process became more permanent/sustainable and the active participation of the individuals were also ensured.

Again, in the same way, Çiftçi (2009), having conducted a similar study, stated that enriching the educational environment by using more sensory organs within the computer-assisted educational settings developed for the hearing-impaired individuals was of great use to them in this respect.

Şılbır (2011) suggested that the computer-assisted environment designed for developing Turkish reading-writing skills of primary school students with hearing

Table 3. The users' task performing periods and their number of clicks

	Task 1 (20 sec expected)		**Task 2 (20sec expected)**		**Task3 (30 sec expected)**		**Task 4 (30 sec expected)**		**Task 5 (40 sec expected)**	
	Access Time (sec)	**No.of Clicks**	**Access Time (sec)**	**No.of Clicks**	**Access Time (sec)**	**No.of Clicks**	**Access Time (sec)**	**No.of Clicks**	**Access Time (sec)**	**No.of Clicks**
Elif	9,7	2	7,4	1	10	2	19,6	2	19	3
Rana	6	1	10	1	14,1	1	12,5	2	14,9	1
Serra	10	1	7	1	23,5	2	11,7	2	15,8	1
Ayşe	17,5	3	5	2	10,1	2	15,9	3	10	2
Ali	3	1	10	1	13,5	2	14,2	2	12	1
Average	9,24	1,6	7,88	1,2	14,2	1,8	14,7	2,2	14,34	1,6

impairment had enhanced their success in their vocabulary as well as their ability to use additional words within a given sentence. The application of the educational software on the young children with hearing-impairment also yielded similar results, and the developed software was understood to have positive effects on learning, maintenance and usability.

CONCLUSION AND SUGGESTIONS

In this study conducted for the hearing-impaired young children, an educational software in compliance with their levels was developed. With this software, it was aimed that such children learn the basic concepts to contribute to their academic success at earlier ages in their primary educational process in order not to fall behind the students with no impairment within the academic scope. In the application process of the research, the hearing-impaired young children were observed to have not much difficulty in general, especially in using the educational software developed. However, interventions for topic repetitions were made for the questions the children were unable to answer, and thus, they were guided in that respect.

The findings of the study suggest that i) the software prepared was quite efficient in allowing the hearing-impaired young children to learn the opposite concepts and emotions, ii) the participants were also capable of maintaining the concepts learned during the maintenance stage after the intervention stage, iii) the usability level of the educational software prepared was appropriate for the young children with IH, and that iv) the software developed according to the subjective evaluations of the teachers of the hearing-impaired was appropriate for the young children with IH.

When the findings of the effectiveness of the study were examined, it was observed that the accuracy percentages of all the participants at the baseline level was rather low (between 19,5% - 47,5%) as regards the concepts expressing both opposite concepts and emotions. However, it was also determined that there was a prominent increase far above the baseline level (between 57,5% - 86,66%) in the wake of the intervention stage during which the teaching processes were performed were completed step by step, and this rapid rate even continued to increase during the maintenance stage, as well (between 97,5%-100%).

When the social validity of the developed educational software that involves the subjective views of the teachers of the hearing-impaired is analyzed, the general average is observed to be almost 4,57 out of 5 in Table 2. The fact that the teachers of the hearing-impaired gave full score (5) to the question, "Do you think the use of this educational software developed for the young children with IH contribute to their learning concepts and emotions?" attracts the attention, as well. While the usability of the educational software was being tested, 5 tasks were already specified, and the performance periods of these tasks by the young children with IH along with the number of clicks were all recorded. The easy-to-use quality and the simple and clear usage of the educational software enable the tasks to be performed in a much shorter time and with one single click. When the findings in Table 3 were analyzed, it was determined that the tasks were easily performed and the system had a high usability.

This study is considered to set an example to other studies to be conducted in this field by creating a digital archive for the young children with IH and to arouse an awareness towards the education of young children with IH. In addition, the study will provide equal opportunities among the young children with IH and will enhance the academic success of the hearing-impaired individuals. It is thought that by providing a suitable educational environment and proper educational tools for the young children with IH, they will be able to perform an academic success at the same level as their peers when sufficient feedback is provided.

As the result of the experiences gained and the assessment of the involved literature in the process of the study, the suggestions for prospective researches have been listed as follows: In order for the educational software to be used by the teachers involved, teacher training programs and applications of the software should be included in this scope. There is also the need to try new/modern software/programs regarding the verbal responses of the children while using the software and evaluating this process. Investigating how the touch-operated mobile applications of the software that facilitate the use of computers for the hearing-impaired children of younger ages could be made in the most convenient form, and thus, developing appropriate suggestions as regards to this will make significant contributions to the literature.

ACKNOWLEDGEMENTS

As for the educational materials prepared in this study, we would like to thank our student, Zeynep Atik, for her contributions in the preparation of the videos in sign language and in taking photos involving the process for the hearing-impaired.

REFERENCES

Alberto, P. A., & Troutman, A. C. (2009). *Applied behavior analysis for teachers* (pp. 311-325). Merrill/Pearson.

Bayırtepe, E., & Tüzün, H. (2007). Oyun-tabanlı öğrenme ortamlarının öğrencilerin bilgisayar dersindeki başarıları ve öz-yeterlik algıları üzerine etkileri. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *33*(33).

Beal-Alvarez, J., Lederberg, A., & Easterbrooks, S. R. (2011). Grapheme-phoneme acquisition of deaf preschoolers. *Journal of Deaf Studies and Deaf Education*. On-line doi: 10.1093/deafed/enr030.

Blackman, J. A. (2002). Early intervention: A global perspective. *Infants and Young Children, 15*(2), 11-19.

Bracken, B. & Crawford, E. (2010). Basic concepts in early childhood educational standards: A 50 state review. *Early Childhood Education Journal, 37,* 421-430.

Cannon, J. E., Easterbrooks, S. R., Gagne, P., & Beal-Alvarez, J. (2011). Improving DHH students' grammar through an individualized software program. Journal of Deaf Studies and Deaf Education, 16(4), 437-457.

Cannon, J. E., Fredrick, L. D., & Easterbrooks, S. R. (2010). Vocabulary instruction through books read in ASL in English language learners with hearing loss. Communication Disorders Quarterly, 31, 98-112.

Carlton M. P. ve Winsler A. (1999) . School Readiness: The need for a paradigm shift, *School Psychology Review, 28*(3), 338-352.

Cunningham, M., & Cox, E. O. (2003). Hearing assessment in infants and children: Recommendations beyond neonatal screening. *Pediatrics, 111*(2), 436-440.

Çakır, H., Çetin, Ş., Baş, A. (2013). İşitme engellilere yönelik dinamik web sayfasının geliştirilmesi, *Bilişim Teknolojileri Dergisi, 6*(2), 1-11.

Çal, C. C.(2011). İşitme engelliler için uzaktan eğitim amaçlı, web tabanlı bir arayüz tasarımı ve uygulaması, Yüksek lisans tezi, Trakya Üniversitesi, Edirne.

Çiftçi E. (2009). İşitme engelli öğrenciler için hazırlanan bilgisayar destekli yazılı anlatım becerisi geliştirme materyalinin tasarımı, uygulanması ve değerlendirilmesi, Yüksek lisans tezi, Karadeniz Teknik Üniversitesi, Trabzon.

Dyck, M.J., Farrugia, C., Shochet, I.M. & Holmes-Brown, M. (2004). Emotion Recognition/ Understanding Ability in Hearing or Vision-Impaired Children: Do Sounds, Sights, or Words make the Difference. *Journal of Child Psychology and Psychiatry*, *45*(4):789–800.

Easterbrooks, S. R. (2010). Evidence-based curricula and practices that support development of reading skills. In M. Marschark, & P. E. Spencer (Eds.), The Oxford handbook of deaf studies, language, and education, Vol. 2 (pp. 111-126). New York: The Oxford University Press.

Easterbrooks, S. R., & Stephenson, B. (2006). An examination of twenty literacy, science, and mathematics practices used to educate students who are deaf or hard of hearing. *American Annals of the Deaf*, *151*(4), 385-397.

Easterbrooks, S. R., & Stephenson, B. H. (2012). Clues from Research: Effective Instructional Strategies Leading to Positive Outcomes for Students Who Are Deaf or Hard of Hearing. *Odyssey: New Directions in Deaf Education*,*13*, 44-49.

Eraslan, E. (2005). E-ticaret web sitesi tasarımının ergonomik açıdan değerlendirilmesi, Ergonomi 12. Ulusal Kongresi (s. 83-90), İstanbul.

Fabes, R. A., Hanish, L. D., & Martin, C. L., (2003). Children at play: The role of peers in understanding the effects of child care. *Child Development, 74*(4), 1039-1043.

Ferrell, K. A., Bruce, S., & Luckner, J. L. (2014). *Evidence-based practices for students with sensory impairments* (Document No. IC-4). Retrieved from University of Florida, Collaboration for Effective Educator, Development, Accountability, and Reform Center website: http://ceedar.education.ufl.edu/tools/innovation-configurations/

Guralnick, M. J. (2010). Early intervention approaches to enhance the peer-related social competence of young children with developmental delays. *Infants and Young Children*, *23*(2), 73-83.

Harrington, M, DesJardin, J., & Shea, L. (2009). Relationships between early child factors and school readiness skills in young children with hearing loss. *Communication Disorders Quarterly*, *XX*(X), 1-13

Hasselbring, T. S., & Glaser, C. H. W. (2000). Use of computer technology to help students with special needs. *The Future of Children*, 102-122.

Karasu, H. P., Girgin, Ü., & Gürgür, H. (2015). İşitme Engelli Bir Çocuğun Okuma Yazma Becerilerinin Dil Deneyim Yaklaşımı İle Desteklenmesi. *Turkish Online Journal of Qualitative Inquiry*, *6*(1).

Laushey, K.M., & Heflin, L. J. (2000). Enhancing social skills of kindergarten children with Autism through the training of multiple peers as tutors. *Journal of Autism and Developmental Disorders, 30*(3), 183-193.

Laushey, K.M., Heflin, L. J., Shippen, M., Alberto, P. A., & Fredrick, L. (2009). Enhancing social skills of kindergarten children with autism through the training of multiple peers as tutors. *Journal of Autism and Developmental Disorders*, *30*(3), 183-193.

McGaha, C. G., & Farran, D. C. (2001). Interactions in an inclusive classroom: The effects of visual status and setting. *Journal of Visual Impairment and Blindness*, *95*(2), 80-94.

MEB (2013). *Okul öncesi eğitim programı.* Ankara: Milli Eğitim Bakanlığı Temel Eğitim Genel Müdürlüğü.

Nielsen, J. (1994). *Usability Engineering*. San Francisco: Morgan Kaufmann.

Odom, S. L., & Strain, P. S. (1984). Peer-mediated approaches to promoting children's social interaction: A review. *American Journal of Orthopsychiatric, 54*(4), 544-557.

Polkosky, M. D. ve Lewis, J. R. (2002). Effect of Auditory Waiting Cues on Time Estimation in Speech Recognition Telephony Applications, *International Journal of Human–Computer Interaction*, *14*(3&4), 423–446.

Richels, C., Bobzien, J., Raver, S. A., Schwartz, K., Hester, P., & Reed, L. (2014). Teaching Emotion Words Using Social Stories and Created Experiences in Group Instruction with Preschoolers who are Deaf or Hard of Hearing: An Exploratory Study. *Deafness & Education International*, *16*(1), 37-58.

Sevinç, S., (1996).İşitme kayıplı çocuklarda eğitimci tarafından verilen eğitim ile bilgisayar destekli eğitimin karşılaştırılması, Yayınlanmamış yüksek lisans tezi, Hacettepe Üniversitesi, Ankara

Shneiderman, B. (1997). Designing information-abundant web sites: issues and recommendations. *International Journal of Human-Computer Studies*, *47*(1), 5-29.

Shonkoff, J. P. & Phillips, D. A. (2000). *From neurons to neighborhoods: The science of early child development*. Committee on Integrating the Science of Early Childhood Development. Washington, DC: National Academy Press.

Stevenson, H. W., & Newman, R. S. (1986). Long-term prediction of achievement and attitudes in mathematics and reading. *Child Development, 57*, 646-659.

Tekin-İftar, E., & Kırcaali-İftar, G. (2006). *Özel eğitimde yanlışsız öğretim yöntemleri*. Ankara: Nobel Yayın Dağıtım.

Tekin Iftar, E., Kurt, O., & Cetin, O. (2011). A Comparison of Constant Time Delay Instruction with High and Low Treatment Integrity. *Educational Sciences: Theory and Practice*, *11*(1), 375-381.

Turan, Z., Küçüköncü, D. T., Cankuvvet, N., & Yolal, Y. (2012). Koklear implant ve işitme cihazı kullanan işitme kayıplı çocukların dil ve dinleme becerilerinin değerlendirilmesi. *Gülhane Medical Journal*, *54*(2).

Tüfekçioğlu, U., (1998). *Özel Eğitim*, Eskişehir: Anadolu Üniversitesi İlköğretim Öğretmenliği Açık öğretim Lisans Tamamlama Programı Yayını.

Uçak, N. Ö., & Çakmak, T. (2009). Web sayfası kullanılabilirliğinin ölçülmesi: Hacettepe Üniversitesi Bilgi ve Belge Yönetimi Bölümü web sayfası örneği. *Türk kütüphaneciliği*, *23*(2), 278-298.

◈◈◈