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The Effects of Three Dimensional (3D) Animated Movies and Interactive Applications on Development of Visual Perception of Preschoolers *

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Abstract

This study is implemented to investigate the effects of three dimensional animated movies and interactive applications series on development of visual perception of five year old (60-72 months) children. The research has been performed in pre-test post-test permanence test experimental pattern with control group. In the study, 12 children (7 girls, 5 boys) in Test Group 1, 12 children (7 girls, 5 boys) in Test Group 2) and 14 children (8 girls, 6 boys) in Control Group were evaluated. 'Personnel Information Form' developed by the researcher, Test of Visual Perceptual Skills-3 developed by Martin (2006), adapted to Turkish language and validity and reliability studies completed by the researchers were used to collect and evaluate the visual perceptual skills of the children. In the study, the test groups watched eight episodes of three dimensional animated movies and performed the interactive applications with computer and worksheets every fifteen day for 16 weeks. Since the data of the research were not distributed normally, non-parametric tests Kruskal-Wallis, Friedman, (pairwise comparison for post-hoc), Mann-Whitney U and Wilcoxon tests were used to analyze the data. The results of the research show that on average and for Sequential Memory and Visual Closure subtests the visual perception of children who attended the training programs were significantly better than that of children who did not. The programs were found to generate significant effect on Test of Visual Perception Skills-3 and its subtests Spatial Relations, Form Constancy and Visual Figure-Ground.

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Introduction

Visual perception is the ability to interpret, analyse and give meaning to what is seen. A very significant part of serebral cortext in the human brain is reserved for visual process. The different parts of the brain is developed to achieve different tasks like seeing and perception of color, depth, ground, movement and alike. Seeing has an advantage of getting the environmental information free from distance which is necessary for touching, smelling and tasting. That's why vision has a superiority and priority in human's life (Farrori & Menon, 2008). For this reason, the visual perception which forms the basis of cognitive development playing an important role in a child's reading and writing skills, needs to be reinforced (Feder & Majnemer, 2007; Akı, Aral, Bütün Ayhan, & Mutlu, 2008).

Visual Perception

Visual perception is a subject for multidisciplinary studies like occupational therapy, psychology, optometry and education (Scheiman, 1997; Hellerstein & Fishman, 1999; Grieve, 2000; Brown, Rodger, & Davis, 2008). Visual perceptual processing is very important, especially during learning. Without visual perceptual processing, many activities in human life like reading, giving or following the given directions, writing, visualizing objects or past experiences, remembering things visually, having good eye-hand coordination, integrating visual information with other senses and etc. would be impossible (Akçin, 1993; Morgan, 1995; Erben, 2005).

The basic skills that form the visual perception are spatial relations, visual discrimination, figure-ground, visual closure, visual memory and form constancy. Spatial relation is to perceive the relative position of a subject; visual discrimination is to distinguish the properties of a subject like color, shape or position; figure-ground is to distinguish a subject from the other subjects sharing the same environment; visual closure is to make a whole from its components; visual memory is to remember the stimulis after a short period of time and form constancy is to recognize a subject although it is demonstrated in a different size, color or pattern (Frostig et al., 1961)

Visual perception starts its development early in infancy, and this is the basis for further development. The development of perception starts with face and movement recognition and develop by age. The infants typically can receive continuous stimuli from lines, patterns, movement, and different light intensities. This enables perception of edges and contours parsing the visual world into components. Infants start to perceive the colour when the colour pathway begins to operate at 2 to 3 months of age. Spatial relations have been shown as early as 3-4 months of age. Infants show sensitivity to above and below and left and right as long as the object is the same. Infants start to react to moving objects at 3 to 5 months of age and distinguish their own leg movements from other moving legs at 3 to 6 months old age. By 9-10 months the spatial relation of 'between' starts to emerge. Later with age, spatial relations are generalized to all objects, and more complex relations are perceived. Perception of depth or three-dimensional features depends on binocular information that is likely to appear with the development of stereopsis, from 4 months of age. Children start to distinguish the shapes if they are closed or not at the age three. Their ability to distinguish and draw the shapes increase by getting age (Bertenthal & Proffit, 1984; Bahrick & Watson, 1985; Boz & Çalıkoğlu Bali, 2003; Arterberry, 2008; Atkinson & Braddick 2011; Kravitz, Saleem, Baker, & Mishkin, 2011). Visual perception is related to a set of skills combined with each other. As a result, it is hard to discriminate the visual skills during the development stage.

It is emphasized that the visual, audial, tactual experiences provided for children have a positive effect on cognitive development and learning. The researchers determine that visual perceptual performance can be increased by both the effect of daily routines or special training programs. In their studies Mangır and Çağatay (1987) determined that eye-hand coordination scores of the children who attend a preschool education program are better than children who don't continue to a preschool education. Kaya (1989) studied the effects of Frostig Visual Perceptual Training Program on visual and cognitive development of children. The study concluded that four year old children in experimental group performed better than the control group on subtests eye-and coordination, figure-ground and

form constancy while five year old children performed better on all subtests. In their study with four-eight years old children diognosed with cerebral palsy, Aral and Erturan (1999) emphasized that Frostig Visual Perceptual Training Program can be used as a supportive tool to develop the visual perception of children with cerebral palsy. Tuğrul, Aral, Erkan, and Etikan (2001) analyzed the effects of Frostig Visual Perceptual Training Program on visual perceptual development of six year old children and determined a significant difference between the pretest and posttest scores on all the subtests excluding figure-ground. Cengiz (2002), Koç (2002) developed their special training programs with the same purpose and reported that both of the programs contrubuted to children's visual perceptual development with a significant difference. Cheung, Poon, Leung, and Wong (2006) investigated the visual perceptual performance of children in Hong Kong by comparing them to the accepted norms on the Developmental Test of Visual Perception-2nd edition. Their research results indicated that there was a ceiling effect in position in space, spatial relations and eye-hand coordination subtests while the difference was not significant between genders except figure-ground subtest. Akaroğlu and Dereli (2012) investigated the effets of educational toys traininig designed to develop visual perceptual skills in children and concluded that visual perception training program with educational toys was effective on increasing the levels of children's visual perception. In their study Kurtulmuş and Temel (2013) examined the effect of Visual Perception Training Program which was applied to pre-school period children on visual perception and drawing skills. The researchers concluded that posttest scores of children in experiment group were significantly higher than their pretest scores on Eye-hand Coordination, Shape-Surface Separation, Perception Constancy, Perception of Position within Space and Perception of Spatial Relationships subtests. Yücelyiğit and Aral (2013) investigated whether the visual perception of 60-to 72-month-old kindergarteners attending a special program that included three-dimensional 3D stereoscopic animated movies and interactive applications differed from that of children who attended only preschool. Their results show that, on average, the visual perception of children who attended the training program was significantly better than that of children who did not. Metin (2014) aimed to identify whether the project-based approach affects the visual perception skills of five-year-old preschool children (60-72 months). The study results indicated that the project-based approach led to a significant difference between the groups in terms of visual perception skill levels, with the study group exhibiting a higher level of visual perception. The recent studies show that the development of visual perception has an integrated and sensitive effect in evaluating child development. Deficits in development of visual perception causes learning disability, hyperactivity, and inadequacy in reading and writing skills (Solan, 1987; Tseng & Chow, 2000; Aral, 2002; Ahmetoğlu, Aral, & Bütün Ayhan, 2008; Aral & Bütün Ayhan, 2003). Some researchers found strong relationship between reading complicacy and visual perception defects, and it is emphasized that low level visio-spatial ability causes lingual problems. It is critical to present substantial stimulus to develop the visual perception during the early years -especially the preschool education- when the visual perception starts its development, to avoid or minimize the academic and daily life troubles (Griffin et al., 1993; Akshoomoff, Stiles, & Wulfeck, 2006; Aral, 2010). Problems in visual perception causes learning difficulties. Children who have weak spatial relations have difficulties to make connection with themselves and the subject or the symbol. The children hesitate about their movements and they confuse the words defining 'space' and 'position' (Erben, 2005). In this context, complementary applications that make learning entertaining and interesting is required. Some applications, reflecting the technological progress, make learning become much more entertaining and interesting for children beginning from the preschool years.

Interactive Tools and Three Dimensional Animated Movies

Developments of graphical and visual applications were pushed forward first in two dimension, then in three dimension and in virtual reality as the last step (Eden, 2007). The new generation movies are mostly presented in stereo and even the preschool children are subject to 3D vision. This study aims to investigate the effects of 3D animations (stereoscopic) and interactive applications on visual perception of preschool children. It is expected that the interactive applications and 3D stereoscopic movies developed to this effect, target the child's audio-visual senses simultaneously and integrate data processing. Nonetheless, these applications and movie develop child's cognitive skills like evaluation and decision making by including child's tact to learning process. It is stated that assisting the five sense to have experiences and transferring the experiences to daily life is critical for long lasting learning. (Murphy, 2009).

Materials like digital applications or computer based training programs developed by using the new technologies have effects on different developmental areas of the children. Shute and Miksad (1997) studied the effects of computer assisted tarining on cognitive development of preschoolers and found that computer assisted instruction soft ware increased verbal and language skills, but not math skills. Carlson and White (1998) explored the effectiveness of a computer program in helping kindergarten students learn the concepts of left and right. They found that students exposed to the software significantly increased their scores on the posttest measure of their understanding of the concepts of left and right. Segers and Verhoeven (2002) developed a child-friendly computer software program to enhance the early literacy skills of kindergarteners in the Netherlands. They stated that amoung the children who used their program the ones who have higher pretest scores were found to show significant gain. Aral and Bütün Ayhan (2003) emphasized that mean scores in Frostig Visual Perception subtests of the children given computer assisted training is higher than the group who were not given computer assisted training. In his study Kim (2006) concluded that the effect of 3D virtual reality on child's attention to the subject and attitude towards the lesson was semantic. Naylor, Keogh, & Downing, (2007) explored the effects of cartoons on child's science learning and indicated that cartoon characters can generate dialogue among pupils, leading them to clarify their thinking, justify their answers to consider the alternative solutions. The researchers pointed out that cartoons promote entertaining and long lasting learning. Dalacosta, Kamariotaki, Palyvos, and Spyrellis, (2009) emphasized that animation movies can easily draw the attention of children -even adults- and have a worthwhile effect on elementary education; through exaggeration and humour that animation movies contain with well-known subjects and images from every child's real life. Lin and Dwyer (2010), concluded their study on the effects of static and animation assisted learning that education using animation and interactive applications provides long lasting learning and strenghtens memory if it is designed by professionals dedicated for a target population. Kayaoğlu, Dağ-Akbaş, and Öztürk (2011) reported that animation technique has contributed to the students' vocabulary learning in their experimental study "Using animations to learn vocabulary". According to the findings of the study of Aktaş, Bulut, and Yüksel (2011) on the "Effect of using computer animations and activities about teaching patterns in primary school" academic performance of the students increased by using computer animations and activities. As seen from the research results, it is thought that using 3D movies and interactive applications as an additional technique can be effective in assisting visual perception. This study is concerned with the difference, if there is, between the development of visual perception of 60-72 months old children attending kindergarten who continue a special program with 3D (stereoscopic) animated movies and interactive applications and who do not continue any program besides their preschool education. The children are subject to three dimensional animated movies and they have access to any kind of interactive applications on smart phones or tablets. The research is important in terms of analyzing and reaching a conclusion about three dimensional animated movies and intercative applications that may have an effect on visual perception of preschoolers.

Purpose of the Study

This study is implemented to investigate the effects of three dimensional animated movies and interactive applications series on development of visual perception of five year old (60-72 months) children. The following questions were considered to address the purpose of the study:

1. Is there a significant difference concerning the average scores of Test of Visual Perceptual Skills-3 and its components between the children who attend the training programme with three dimensioanal animated movies and interactive applications and who do not attend.
2. Is there a significant difference between the average Test of Visual Perceptual Skills-3 and its subtests' pretest and posttest scores?

Method

The research has been performed in pretest posttest permanence test, experimental pattern with control group. The dependent variable of the study is the 'visual perceptual skills' of children and the independent variable is 'three dimensional animated movies and interactive applications' which may have an effect on children's visual perception.

Participants

The research was carried out with two kindergartens both of which are member of Ministry of Education in Ankara, Turkey. The kindergartens and test and control groups were selected randomly. The sample of 40 children; 26 in one kindergarten (test groups) and 14 in the other kindergarten (control group) were between 60-72 months, living with their parents, displayed a normal development. Two of the children in test groups decided not to participate the study. Rest of the children accepted to participate, so the study was accomplished with 38 children, 12 (7 girls and 5 boys) of whom were in Test Group 1, 12 (7 girls and 5 boys) of whom were in Test Group 2 and 14 (8 girls and 6 boys) of whom were in Control Group.

Of the Test Group 1 who were administered a training program with interactive applications and three dimensional animated movies, %58,3 were girls and %41,7 were boys, %66,6 were the last child of the family, %58,3 had one sibling; of the Test group 2 who were administered a training program with three dimensional animated movies and worksheets of the interactive applications, %58,3 were girls and %41,7 were boys, %33,3 were the first, %33,3 were the middle and %33,4 were last child of the family, %58,3 had one sibling; and of the Control Group who were not administered any special training program, %57,1 were girls and %42,9 were boys, %57,2 were the first child of the family, %50 had one sibling.

Data Collection Instruments

In the study, Personal Information Form designed by the researchers was used to collect the demographic information like age, gender, birth sequence, siblings and occupancy of parents. Level of the child's visual perception was evaluated by Test of Visual Perceptual Skills-3 developed by Martin (2006) and adopted to Turkish language by the researchers. The validity and reliability studies of the test was completed by the researchers as well.

Test of Visual Perceptual Skills-3 assesses visual perceptual abilities without requiring motor involvement. Martin (2006) utilized 112 black and white designs chosen from the previous editions (TVPS-R-Gardner 1996, TVPS-UL-Gardner 1997) and formed seven subtests with the names Visual Discrimination, Visual Memory, Spatial Relationships, Form Constancy, Sequential Memory, Visual Figure-Ground and Visual Closure. Each of the subtests starts with non-scored two examples and are followed by 16 test items arranged in order of difficulty. Test is multiple choice, the child needs to indicate an answer verbally or by pointing. Each correct answer is scored as 1 and and the test ends if three sequential answers are scored as 0 or if the child wants to stop.

The adoptaion of the Test of Visual Perceptual Skills-3 started after getting permission from Dr. Martin to use the test with the preschool children in Turkey. For this aim first the test was translated into Turkish by two people who are fluent in both Turkish and English. The Turkish forms were then reinterpreted to English by language specialists and were compared with the original forms. Both the Turkish forms and their originals were presented to seven academic child developers working at different universities in Turkey. After the pilot study, it is observed that children had no difficulties in following and applying the directions of the adopted version of the test items. The validity-reliability study was carried out with normally developed 202 children who accepted to participate the study in three different schools which are choosen randomly.

In order to ascertain the validity of the Test of Visual Perceptual Skills-3, construct validity and criterian-related validity were considered. According to the Exploratory Factor Analysis (EFA) results, amoung 112 test items distrubuted in seven subtests, seven of test items (1,3,49,50,51,95,96) were excluded from the Turkish form due to their low level of factorial loads (below 0.20). In order to provide additional proofs the model was tested by Confirmatory Factor Analysis (CFA) and for Test of Visual Perceptual Skills-3 and it's seven subtests, fit indices were found to be coherent with the model. For further proofs on construct validity children's age and teachers' review were assessed. The scores of children who were declared to have strong visual perception by their teacher's, were significantly higher than the score of children who were declared to have weak visual perception. Kuder Richordson-20 (KR-20) internal consistency coefficient, and test-retest correlation coefficients were computed to achieve the reliability. As a result of the reliability and validity analysis, Test of Visual Perceptual Skills-3 was found to be a reliable and valid scale for the implementation with preschool children between 60-72 months old.

Collection of Data

The training programme used in the study consists of two components. These are eight episodes of three dimensional animated movies and interactive applications. Both of the compponents were developed considering the national preschool curriculum, supporting the aims and acquisitions of the development of preschool children. The contributions to the developmental areas listed in national preschool curriculum are planned as follows: Eye-hand coordination during the touchscreen application refers to the motor development, the themes of the movies like 'friendship' refer to social-emotional development, the language used both in the movies and the applications enhance the vocabulary of the children which refers to language development, concepts like shapes, colors presented in the movies and the applications refer to cognitive development and the themes of the movies like 'sleeping time' refer to physical health and well-being. Interactive applications are computer based programs, generating multiple choice cases with During the application each child hear the instructions and see the visuals for the instructions at the same time. When the child is ready to give a decision about the case, the screen changes and options are presented on the screen. Giving a decision, the child marks his/her choice by touching the screen.

Figure 1. Sample Screen for Interactive Application

Figure 2. Sample Screen for 3D Animated Movies

The target audience for 3D movies are preschool children. Each episode last 10 minutes. Titles of the movies are as following: I'm a Preschooler, I Love My Friends, Eating Healthy Food, Use Of Resources, Be quiet, I'm Sleeping, This Is My Hobby, I Love Animals, Keeping Fit, Wondering The Sky. The movie characters are also preschool children and in every episode the characters achieve a different task at the school that the audience can empathize.

For the study, 12 of the children participating in Test Group 1 continued the training program with three dimensional animated movies and interactive applications using computer while 12 of the children participating in Test Group 2 continued their program with three dimensional animated movies using the worksheets of the interactive applications. Both test groups were presented the three dimensional movies after their application session every fifteen day for 16 weeks. The control group in the other school merely followed their preschool program.

The children in test and control groups were administered Test of Visual Perceptual Skills-3 individually to evaluate their visual perceptual levels through Decemeber 7 to 11, 2012. The children in test groups were presented three dimensional animated movies from December 14, 2012 to March 25, 2013. The training program was given via a specially designed setup. The setup consisted o f a seven square meter screen, two projectors providing the stereoscopic 3D vision, a computer with a touch-screen. At first, the setup is introduced to the children and children are fostered to investigate the setup. After giving a short information about the interactive applications the implementation starts. During the application, each child has an opportunity to make a choice for one case by touching the screen and has a feedback by the soft ware for his/her choice. While the child makes his/her choice on the touch screen, the other children watch it from the projector screen. It is important that every child has at least one turn to participate the interactive application. The children participating the Test Group 2 were presented screenshots of the same applications on paper. After the interactive application is completed, children wear their polarized eyeglasses and watch three dimensional animation movie for ten minutes.

After complating eight episodes of three dimensional animated movies and interactive applications all of the children in test and control groups were administered posttest between 25th and 29 th March 2013. To evaluate the permanence of the training program it is recommended to administer the permanence test after three to six weeks (Büyüköztürk, 2013). The permanence test was administered between 29th April 2013 and 3rd May 2013.

Evaluation and Analysis of the Data

The personal information and pretest, posttest, permanence test results of children were recorded by office and statistics programmes. The data of the research were evaluated in terms of normality assumption and the results showed that total score didn't meet the normality assumption ($P<0.05$). So, non-parametric statistics were administered in data analysis. For the comparison of the test scores between the groups, since the number of the groups is three (Test 1, Test 2 and Control), Kruskall Wallis test was administered. For the repeated measures in test groups, since the number of the repeating test is three (pretest-posttest and permanence), Friedman Test was administered. For the results of control group Wilcoxon Test was administered.

Findings and Discussion

The results of the research show that on average and for Sequential Memory and Visual Closure subtests the visual perception of children who attended the training programs were significantly better than that of children who did not. According to the comparison of the pretest-posttest results the programs were found to generate significant effect on Test of Visual Perception Skills-3 and its subtests Spatial Relations, Form Constancy and Visual Figure-Ground. The results are shown in Table 1 and Table 2 below:

Table 1. Kruskall Wallis Test Results of the Children in Tset and Control Groups for Test of Visual Perceptual Skills-3 and Its Subtests

Test	Group	n	Mean	S.D.	Mean Rank	df	$\chi 2$	P	Significance	EB
Test of Visual Perceptual Skills-3										
Pretest	Test 1	12	23.33	12.76	24.58	2	5.03	0.08		
	Test 2	12	16.83	8.51	19.88					
	Control	14	13.64	3.59	14.82					
Posttest	Test 1	12	24.75	14.6	20.96	2	5.96	0,05*	T2-C (U=37,5)	0,458
	Test 2	12	26.42	10.53	24.42					
	Control	14	16.43	7.05	14.04					
Test of Visual Perceptual Skills-3 Visual Discrimination subtest										
Pretest	Test 1	12	2	2.41	20.83	2	0.36	0.84		
	Test 2	12	1.67	2.15	19.54					
	Control	14	1.29	1.64	18.32					
Posttest	Test 1	12	2	2.3	20.58	2	1.68	0.43		
	Test 2	12	2.58	2.64	21.79					
	Control	14	1.29	1.64	16.61					
Test of Visual Perceptual Skills-3 Visual Memory subtest										
Pretest	Test 1	12	4.42	3	19.17	2	1.59	0.45		
	Test 2	12	5.25	3.25	22.58					
	Control	14	4	2.07	17.14					
Posttest	Test 1	12	6.08	2.78	19.5	2	1.33	0.51		
	Test 2	12	6.5	2.24	22.17					
	Control	14	5.07	2.49	17.21					
Test of Visual Perceptual Skills-3 Spatial Relationship subtest										
Pretest	Test 1	12	3.67	22	4.05	2	5.21	0.07		
	Test 2	12	1.33	1.72	13.54					
	Control	14	2.64	1.5	22.46					
Posttest	Test 1	12	3.83	17.92	4.17	2	3.96	0.14		
	Test 2	12	5.58	3.53	24.67					
	Control	14	2.86	2.31	16.43					
Test of Visual Perceptual Skills-3 Form Constancy subtest										
Pretest	Test 1	12	2.67	1.56	25.67	2	6.09	0,05*	T1-C (U=37)	
	Test 2	12	1.83	1.95	18.08					
	Control	14	1.21	1.05	15.43					
Posttest	Test 1	12	1.5	2.43	19.04	2	0.06	0.97		
	Test 2	12	1.67	2.53	20.04					
	Control	14	1.07	1.38	19.43					
Test of Visual Perceptual Skills-3 Sequential Memory subtest										
Pretest	Test 1	12	3.67	3.96	24.83	2	4.74	0.09		
	Test 2	12	1.67	2.19	18.33					
	Control	14	1.21	1.8	15.93					
Posttest	Test 1	12	4.67	3.26	26	2	6.31	0,04*	T1-C (U=39,5)	0,454
	Test 2	12	2.42	3.31	17.17					
	Control	14	2.14	3	15.93					
Test of Visual Perceptual Skills-3 Visual Figure-Ground subtest										
Pretest	Test 1	12	4.75	1.91	28.83	2	14.45	0,00**	T1-T2 (U=28)	
	Test 2	12	2.75	1.42	17.92				T1-C (U=16)	
	Control	14	2	1.24	12.86					
Posttest	Test 1	12	3.92	3	19.5	2	4.22	0.12		
	Test 2	12	4.83	2.55	24.29					
	Control	14	2.71	1.32	15.39					
Test of Visual Perceptual Skills-3 Visual Closure subtest										
Pretest	Test 1	12	2.17	1.58	21.58	2	2.29	0.23		
	Test 2	12	2.33	1.82	22					
	Control	14	1.28	1.38	15.57					
Posttest	Test 1	12	2.75	1.66	23.25	2	7.42	0,02*	T1-C (U=40)	0,456
	Test 2	12	2.83	1.85	23.08				T2-C (U=40)	0,457
	Control	14	1.28	1.44	13.21					

*P<.05, **P<.01

Table 1 shows that while there isn't a statistically significant difference between the pretest scores of the children in the Test and Control groups on Test of Visual Perceptual Skills-3 (χ2=5.03, P>.05) the difference between the posttest scores is significant (χ2=5.96, P<=05). To determine the relating two groups with significant difference Mann Whitney-U test is administered and the result of this test shows that the difference is between Test 2 and Control groups (U=37,5 P<.05). The effect size of this difference is calculated as 0,458 (Cohen, 1988). Examining the Kruskal Wallis Test results for the subtests of Test of Visual Perceptual Skills-3, it is seen that the differences between the posttest scores for the subtests Sequential Memory (χ2=6.31, P<.05) and Visual Closure (χ2=7.42, P<.05) are statistically significant as well. For further analysis Mann Whitney U test is administered and the results show that for Sequential Memory subtest, the significant difference is between Test Group 1 and Control Group (U=39,5, P<.05) and for Visual Closure subtest, there is a significant difference between both Test Group 1-Control Group (U=40, P<.05) and Test Group 2-Control Group (U=40, P<.05). The effect size of the difference between the groups for Sequential Memory subtest is calculated as 0,454 and for Visual Closure as 0,456 for Test Group 1 and 0,457 for Test Group 2. (Cohen,1988). These findings show that for Visual Closure subtest the scores of the children in both of the test groups are significantly higher than the scores of the children in control group and for the Sequential Memory subtest scores of the children in the Test Group 1 is significantly higher than the scores of the children in control group.

In their experimental studies Kaya (1989), Aral and Erturan (1999), Tuğrul et al. (2001), Bezrukikh and Terebova (2009) explored the effects of Frostig Visual Perception Training Program while Cengiz (2002), Koç (2002) and Demirci (2010) studied the effects of the programs they developed on preschool children's visual perceptual development. The research results show that each training program used in these studies support the visual perceptual development of the children. Aral and Bütün Ayhan (2003) emphasized that mean scores in Frostig Visual Perception subtests of the children given computer assisted training is higher than the group who were not given computer assisted training In their research Lin and Dwyer (2010) studied the effects of static and animated supported learning and concluded that the animated movies and the interactive applications promote entertaining and long lasting learning and strengthens the memory. This result of Lin and Dwyer's study supports the findings of this study. It is thought that the three dimensional animated movies, interactive applications presented both with computer and paper have positive effect on development of visual closure. Combining the images while following the movie and during the script flow makes a progress on development of visual closure skills. The animated movies and the interactive applications provide appropriate visuals for developing the figure-ground and possibility to make practice upon this. The practice helps children to complete the figures that are given partially. . It is believed that the touch screen applications with animated movies address all five senses which provides long lasting learning and strenghtens memory.

Table 2. The Results of Friedman Test for Pretest-Posttest Scores of the Children in Test and Control Groups for Test of Visual Perceptual Skills-3 and Its Subtests

Group	Test	Mean	S.D.	Mean Rank.	df	$\chi 2$	P	Significance	EB
Test of Visual Perceptual Skills-3									
Test1	Pretest	23.33	12.76	1.79	2	0.91	0.63		
	Posttest	24.75	14.6	2.04					
	Permanence	28.41	11.87	2.17					
Test2	Pretest	16.83	8.51	1.29	2	9.52	0,01*	Pretest-Posttest (P=0.02**)	0,795
	Posttest	26.42	10.53	2.42					
	Permanence	31.42	16.77	2.29					
Test of Visual Perceptual Skills-3 Visual Discrimination									
Test1	Pretest	2	2.41	2	2	1.25	0.53		
	Posttest	2	2.29	2.21					
	Permanence	1.42	1.78	1.79					
Test2	Pretest	1.67	2.15	1.5	2	5.89	0,05*		
	Posttest	2.58	2.64	2.29					
	Permanence	2.83	2.69	2.21					
Test of Visual Perceptual Skills-3 Visual Memory subtest									
Test1	Pretest	4.42	2.41	1.79	2	2.18	0.34		
	Posttest	6.08	2.29	2.33					
	Permanence	5	3.57	1.88					
Test2	Pretest	5.25	3.25	1.79	2	0.83	0.66		
	Posttest	6.5	2.24	2.08					
	Permanence	6.83	4.61	2.13					
Test of Visual Perceptual Skills-3 Spatial Relationships subtest									
Test1	Pretest	3.67	4.05	1.88	2	7.32	0,03*	Posttest-Perm. (P=0.06)	
	Posttest	3.83	4.17	1.58					
	Permanence	5	3.57	2.54					
Test2	Pretest	1.33	1.72	1.08	2	17.9	0,00**	Pretest-Posttest (P=0.00**)	1,031
	Posttest	5.58	3.53	2.38					
	Permanence	6.83	4.61	2.54				Pretest-Perm. (P=0.00**)	
Test of Visual Perceptual Skills-3 Form Constancy subtest									
Test1	Pretest	2.67	1.56	2.21	2	7.37	0,03*	-	
	Posttest	1.5	2.43	1.42					
	Permanence	2.83	1.53	2.38					
Test2	Pretest	1.83	1.83	1.83	2	6.65	0,04*	-	
	Posttest	1.67	2.53	1.95					
	Permanence	3.75	3.05	2.54					
Test of Visual Perceptual Skills-3 Sequential Memory subtest									
Test1	Pretest	3.67	3.96	1.71	2	1.64	0.44		
	Posttest	4.67	3.26	2.17					
	Permanence	4.67	3.26	2.13					
Test2	Pretest	1.67	2.19	1.92	2	0.93	0.63		
	Posttest	2.42	3.31	1.88					
	Permanence	3.67	3.87	2.21					
Test of Visual Perceptual Skills-3 Visual Figure-Ground subtest									
Test1	Pretest	4.75	1.91	2.17	2	0.63	0.73		
	Posttest	3.92	3	1.88					
	Permanence	4.67	2.77	1.96					
Test2	Pretest	2.75	1.42	1.42	2	7.26	0,03*	Pretest-Posttest (P=0.04)*	0,706
	Posttest	4.83	2.55	2.42					
	Permanence	4.33	2.74	2.17					
Test of Visual Perceptual Skills-3 Visual Closure subtest									
Test1	Pretest	2.17	1.58	1.58	2	4.65	0.1		
	Posttest	2.75	1.66	2.13					
	Permanence	3.33	2.1	2.29					
Test2	Pretest	2.33	1.82	1.79	2	0.93	0.63		
	Posttest	2.83	1.85	2.13					
	Permanence	3.75	2.89	2.08					

*P<.05, **P<.01

The results of Friedman Test in Table 2 show that there is a significant difference between the Test of Visual Perceptual Skills-3 pretest-posttest-permanence test total scores in Test Group 2 ($\chi 2$=9.52, p<.01). To determine the relating two groups with significant difference post-hoc for multiple comparison is administered and the result shows that the statistically significant difference is between pretest and posttest scores on behalf of the posttest score. The effect size of the difference between the test scores is calculated as 0,795 (Cohen, 1988). This result points out that the training program with three dimensional animated movies and applications on paper generate a significant effect on children's visual perceptual development in Test Group 2. The difference between the pretest-posttest-permanence test scores for Spacial Relations subtest in both of the Test Groups 1-2 is significant as seen from Table 2 (Test 1 $\chi 2$=7.32, P<.05; Test 2 $\chi 2$=17.90, P<.01). The effect size of the difference between the scores in Test Group 2 is calculated as 1,031 which can be interpreted as a strong effect (Cohen, 1988). This result shows that the training program with three dimensional animated movies and applications both with computer and worksheets, generate a significant effect on children's visual perceptual development in Test Groups 1-2. The difference between the pretest-posttest-permanence test scores for the Form Constancy subtest in Test Groups 1-2 is significant (Test Group 1 $\chi 2$=7.37, P<.05; Test Group 2 $\chi 2$=6.65, P<.05). To determine relating two groups with significant difference, post-hoc for multiple comparison tests is administered and result shows that the difference is not significant. It is thought that although the training program with three dimensional animated movies and the interactive applications have a positive effect on development of visual perception of the children, it is not found statistically significant on form constancy subtest. In the Test Group 2 the difference between the pretest-posttest-permanence test scores for the Visual Figure-Ground subtest is significant ($\chi 2$=7.26, P<.05). To determine relating two groups with significant difference, post-hoc for multiple comparison tests is administered and result shows that the statistically significant difference is between pretest and posttest scores on behalf of the posttest score. The effect size of the difference between the scores in Test Group 2 is calculated as 0,706 (Cohen, 1988). This result shows that the training program with three dimensional animated movies and interactive applications with computer generate a significant effect on children's visual perceptual development in Test Group 2.

The results of the study point out that interactive applications and three dimensional animated movies support the development of visual perception. During the movie projection children use their muscle bulbi while following the movie characters and the script flow; and they also focus and change their focal point each of which require eye movements. Nonetheless making a choice on touch-screen by touching the focal point, helps the development of eye-motor coordination. It is clear that both the animated movies and the interactive applications provide appropriate visuals for developing the figure-ground and possibility to make practice upon this. It is thought that stereoscopic 3D display supports depth perception and visual development of position in space and spatial relationship. Since target audience for the movies are preschoolers, colors and forms that attract children's attention were used to introduce colors, shapes and to help discriminating them under different media and circumstances. Çağatay (1985) studied the effects of Frostig Visual Perception Education Program on children with cerebral palsy and concluded that there is a significant difference between the pretest and posttest scores of the children in Test Group while there isn't any difference among the scores of children in Control Group. Tuğrul et al. (2001) analyzed the effects of Frostig Visual Perceptual Training Program on visual perceptual development of six year old children and determined a significant difference between the pretest and posttest scores on all the subtests excluding figure-ground. In their study Cheung et al. (2006), compared the visual perceptual norms of children in Hong Kong with Developmental Visual Perceptual Test-2 and concluded that there is a significant difference on position in space, spacial relationships, and eye-hand coordination subtests. The results of this recent study supports the findings

of this study relating to Spatial Relations subtest. Demirci (2010), Akaroğlu and Dereli (2012), Kurtulmuş and Temel (2013) concluded their studies that form constancy can be enhanced by the support of the training programs developed for this aim. The result of this study shows a significant difference between the test scores on behalf of post test scores, underline a similar effect. It is thought that to extend the duration and to decrease the frequency of the implementations will help to make the difference statistically significant. The results of the study on figure-ground subtest demonstrate that three dimensional animated movies and the interactive applications using worksheets provide a variety of visual images that promote figure-ground perception. Since target audience for the movies are preschoolers, colors and forms that attract children's attention were used to introduce colors, shapes and to help discriminating them under different media and circumstances. Koç (2002) concluded his study that the sample program administered to elementary school students made a significant difference between the scores of test group and the control group on behalf of the test group on eye-hand coordination, figure-ground perception, spatial position and spatial relationship subdimensions. This finding supports the significant difference between pretest and posttest scores in Test Group 2.To conclude, the findings of the research show that the training program using three dimensional animated movies and interactive applications have a significant effect on total scores of Test of Visual Perceptual Skills-3 and some of its subtests while there is no significant difference on some other subtests. The possible reasons for this result are listed below:

Period of implementations: In the study, the children were presented the research material for eight sessions in 16 weeks time period. It is thought that eight sessions is not enough to make a significant effect on some components of visual perception.

Frequency of implementations: During the preschool years children are impressed by their environment very easily and frequently. Repetition enhances their learning during this period. In the study children were presented the three dimensional animated movies and the interactive applications every fifteen day. It is believed that this frequency is too long to make a significant effect for some components of visual perception.

Method of implementations: The children in experimental groups were administered the research material with groups of 12 children. Although the number of children makes no difference on movie sessions, it limits the effects on child's visual perceptual development on intreactive application session since it decreases the number of opportunity set. It is believed that with smaller groups the effects would be stronger.

Consistency of the test and its subtests with the training program: Although it was intended to effect all the developmental areas with 3D animated movies and interactive applications, the training program failed to result with the similar effect on all subtest areas. The content of the movies and the applications can be considered with a revised approach to eliminate this concisitency.

The qualifications of the teachers of test and control groups: Comparing the bachelor degrees of the teachers in the study groups, it is seen that each teacher has graduated from the Early Childhood Education programs of the universities. Comparing the experience of the teachers it is seen that the teacher of Test Group 1 has an experience of 24 years, the teacher of Test Group 2 has an experience of 22 years and the teacher of Control Group has an experience of 14 years. The test group teachers are at the end of their professional lives which may cause a lack of motivation. It is assumed that physical or mental fatigue depending on long period of service can limit the contributions to child's development. During the visits to school, it is monitored that the children in test groups were mostly spending their time on their own while the control group was leaded different types of activities with their teacher which makes a positive effect on child's development. Although the physical qualifications of test group schools were the same, contributions of the teachers to children's development was not at the same level.

The variety of educational programs in test and control groups: The annual plans of the teachers were examined to determine the acquisitions that may support the visual perceptual skills of the children. The number of acquisitions supporting the visual perception ranked among the annual plans of test group teachers was numerically more but it was monitored that the acquisitions were not implemented thoroughly in test groups while it was implemented efficaciously in the control group. This report helps to clarify the case situation.

Results and Recommendations

Visual perceptual skills can be supported by any kind of digital or paperwork applications as well as technological implementations which enrich the visual aura of the children. According to the research results, the three dimensional animated movies and interactive applications using worksheets and touchscreen computer used as the material of the study, has an effect on some of the subdimensions of visual perceptual development. On the other hand it is determined that on some subdimensions the same effect could not be monitored. From this point of view the recommendations to parents, teachers and researchers are as follow:

Instructions about the effects of three dimensional animated movies which children have the opportunity to watch on tv and at cinemas can be given to parents and preschool teachers. To enrich the visual aura of the children they can be presented high quality three dimensional animated movies that helps the visual perceptual development. Parents and preschool teachers can be informed about the deficiency in development of visual perception. Their awareness can be raised to determine and solve the deficits in visual perception of children. Since the field of studies on digital technologies and education is developing rapidly the new scientific results concerning this field can be shared with educators and researchers so that educators have opportunity to include them in their annual programs and researchers can improve the researches. When taken into account the effects on development of children, the role of preschool teachers is considerably more important than the material used or the method applied. For the maximum output, the awareness of the educators can be raised about their effects on child's development. The researchers can be supported to make studies on new technologies like three dimensional animated movies or interactive applications which is in common use on 3D screens and theatres or smart devices. New applications that will meet the interest and expectations of the children can be developed according to the research results. The research can be repeated by using the same material, enlarging the implementation period and shortening the frequency and the results can be compared. The research can be repeated by using the same material, evaluated by a different test and the results can be compared.

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