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An investigation of the effect of puzzle design on children’s development areas *

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Abstract

This study aimed to explore the effect of puzzle design on preschool children’s development areas (cognitive, linguistic, motor, social, and emotional development). Randomly selected children with normal development who attend a preschool as part of a primary school in Ankara under the guidance of the Ministry of National Education were involved in the study. Then, two classrooms were randomly selected and one of the two was assigned as an experimental and the other as a control group by chance. Each of them consisted of 14 children with normal development. Data were collected through the Turkish version of the ‘The Brigance Early Development Inventory II’ (Brigance, 2004) adapted by Aral et al. (2008) to determine children’s development areas (cognitive, linguistic, motor, social and emotional development) in addition to the ‘General Information Form’. Since the children’s scores in the Brigance Early Development Inventory II did not show normal distribution, Mann-Whitney U and Wilcoxon Signed-Rank tests were used to analyze the data. It was concluded that no significant differences between experimental- and control-group children’s pre- and post-test subscale scores of the Brigance Early Development Inventory II were found according to the Mann-Whitney U test (p>.05). However, the difference between control- and experimental-group children’s pre- and post-test mean subscale scores of the The Brigance Early Development Inventory II was found significant (p<.05).

Keywords: Early child education, development areas (cognitive, linguistic, motor, social and emotional development), puzzle design.

Introduction

The most important educational materials at preschool educational institutions and home environment are play and play materials. Children identify and evaluate what is happening in their surrounding and outside world through the medium of play materials. Play materials are the most valuable means for stimulating intelligence, senses and emotions; and developing the imagination and creativity of the child, as well as supporting physical, spiritual and social development. Defined as a subcategory of play materials, educational materials provide child’s learning through playing and accordingly helping them form some concepts and understand objects and events in a better way (Daoost, 2007; Tuğrul, 2007; Aral, Gursoy & Can Yaşar, 2011; Kandır & Tezel Şahin, 2011).

Educational materials are defined as toys which enable children to learn as they play as they are systematically designed so as to support children’s cognitive, language and self-care skills while making a great contribution to their social-emotional and motor skills (Avci, 1999). In this respect, educational materials are important at educational settings since they are visual, entertaining, attractive and arousing children’s will to participate (Lederman, 1987). Puzzles which are regarded as an educational material are used for various age groups and make a positive contribution to children’s cognitive, language, motor and social-emotional development.

Puzzles support learning through playing; at the same time they make a positive contribution to the development of mental skills such as perception, recollection, resolution, making analysis, forming part-whole relationship, concentration and making observations (Arslan, 2000; Aral, Kandır & Can Yaşar, 2002; Dodge, Colker & Heroman,
In addition, group work puzzles allow children to interact with each other and give them opportunities to do the puzzle cooperatively; thus puzzles provide important attainments for receptive and expressive language skills (Oğuzkan, Tezcan, Tür & Demiral, 1992; Atalay & Aral, 2001). While children are completing the puzzles individually they obtain some skills such as; carrying out the activity for a certain time, sharing, cooperation, waiting for their turn, obeying the rules, concentration, self-confidence, self-regulation, respect for others and listening skills (Oğuzkan & Avcı, 2000).

Children in early years are known to be curious explorers having a vast amount of imagination. During this period, children are in need of stimulating educational materials providing opportunities for them to satisfy their curiosity, form cause-effect relationships and predict the future by putting forward some ideas. All in all, it can be suggested that puzzles are likely to have effect upon facilitating young children’s developmental domains, fostering their creativity, critical thinking, problem solving, analysis and decision making skills. From this point of view this study intends to investigate the effect of puzzle prototype activities on preschoolers’ developmental areas (cognitive, language, motor, social and emotional development).

Method
In this study experimental design with pretest, posttest control group was used. In this sense, the dependent variable is children’s developmental domains whereas educational program with the implementation of puzzle prototypes is the independent variable.

Participants
Randomly chosen children who show normal developmental characteristics from nursery classes of primary schools in Ankara city center during 2008-2009 academic years took part in this study. Among the randomly picked schools, two classes were chosen as control and experimental groups using random sampling methods. Sampling consists of 28 children, 14 of which were included in control group and the other 14 were included in experimental group. It was found that 50.0 % of the children included in the test group was female, 50.0 % male, while in control group, 42.9% was female and 57.1% male. 35.7% of the children in the test group and 57.1% of the children in control group were first child while 42.9 % was the first child and the majority of the children (test: 71.5%, control: 57.2%) had two sibings. It was determined that 57.2% of the mothers of the children included in the test group and 64.3% of those of the children in the control group were graduates of a high school; 42.9% of the fathers of the children in the test and 57.2% of those of the children in the control group were graduates of a university.

Data Collection
In this research General Information Form and ‘Brigance Early Development Inventory II’ was used.

**General Information Form** includes items such as the child’s date of birth, gender, and number of siblings, birth order, and parents’ educational status were given in General Information Form. General Information Forms were filled out by parents.

**The Brigance Early Development Inventory II** (Brigance, 2004) is designed to evaluate the development of children from birth to age 7. It includes the following five subdimensions: motor skills, receptive and expressive language skills, academic/cognitive skills, social emotional skills, and daily life skills. Each correct answer is awarded 1 point, while incorrect responses receive no points. The total score for the inventory is calculated by adding a separate score for each subdimension and the sum of the scores obtained from the subdimensions. The higher the subdimension and total scores the more advanced are the general development skills. The inventory takes from 20 to 55 minutes to complete, depending on the child’s age (Brigance). The Brigance Early Development Inventory II was adapted for use in Turkey by Aral et al. (2008) with a study sample comprising 464 Turkish children under the age of 6. Correlations among all subdimensions were significant ($p<.01$); internal consistency reliability coefficients varied between .67-.98; testretest correlation revealed consistent results over time ($r=.72-.96$); concurrent validity results were consistent ($p<.05$, $p<.01$); lower 27% and upper 27% item analysis showed the items of the inventory had acceptable levels of discriminant validity.
Puzzle Prototypes and Educational Program

A total number of ten puzzles including themes such as self-recognition, my school, my family and home, emotions, Ataturk, social rules, animals around us, sea animals, changes around us and colors were designed in parallel with the yearly plan so that the puzzles were appropriate for six year old children’s developmental characteristics. While designing the puzzles, extra care was given to the clues to connect the interlocking pieces of the puzzles together with their color, shape, size, composition and total number of pieces. In parallel to the goals and attainments mentioned in the yearly plan, an educational program was eventually prepared. In the plan, there are games that can be played progressively.

Implementation

As a pre-test ‘Brigance Early Development Inventory II’ was administered to children in both the control group and the experimental group before puzzle prototype treatment was implemented. Then, the education program developed including the use of 10 puzzle prototypes was followed with experimental group two days a week, one session a day (approximately 60 minutes) for a five week period. Finally, the children in both the control and the experimental group were given the posttest.

Data Analysis

Shapiro-Wilk Test was used to investigate whether the scores of the children from ‘Brigance Early Development Inventory’ showed normal distribution or not. As a result, it was found out that the pretest and posttest scores of the children both in the control and the experimental group didn’t show normal distribution. For this reason, the differences between the control and the experiment group was analized through the use of Mann-Whitney U test; whereas Wilcoxon Signed Rank Test was used in order to find out any differences between the pretest and posttest mean scores of the children in both groups (Büyüköztürk, 2009).

Findings

Table 1. Mann-Whitney U Test results according to the pretest scores of the children in both groups

| The Brigance Early Development Inventory II | Groups     | Mean Rank | Mann-Whitney U-Test U | p    |
|--------------------------------------------|------------|-----------|------------------------|------|
| Academic/Cognitive Skills                  | Experimental | 15.0      | 90.5                   | .730 |
|                                            | Control    | 14.0      |                        |      |
| Receptive and Expressive Language Skills   | Experimental | 16.5      | 69.5                   | .190 |
|                                            | Control    | 12.5      |                        |      |
| Social Emotional Skills                    | Experimental | 16.2      | 74.5                   | .266 |
|                                            | Control    | 12.8      |                        |      |
| Motor Skills                               | Experimental | 17.2      | 60.5                   | .084 |
|                                            | Control    | 11.8      |                        |      |
| Daily Life Skills                          | Experimental | 16.8      | 65.5                   | .134 |
|                                            | Control    | 12.2      |                        |      |

(n=14)  p>.05

Table 1 shows that there was no significant difference found between the experimental and control group children according to their pretest scores from academic/cognitive skills (U=90.5, p>.05), receptive and expressive language skills (U=69.5, p>.05), social emotional skills (U=74.5, p>.05), motor skills (U=60.5, p>.05) and daily life skills (U=65.5, p>.05) subdimensions of Brigance Early Development Inventory II.

Table 2. Mann-Whitney U Test results according to the posttest scores of the children in both groups

| The Brigance Early Development Inventory II | Groups     | Mean Rank | Mann-Whitney U-Test U | p    |
|--------------------------------------------|------------|-----------|------------------------|------|
| Academic/Cognitive Skills                  | Experimental | 14.8      | 94                     | .854 |
|                                            | Control    | 14.2      |                        |      |
| Receptive and Expressive Language Skills   | Experimental | 15.6      | 82.5                   | .475 |
|                                            | Control    | 13.4      |                        |      |
Table 2 presents that the differences between academic/cognitive skills (U=94, p>.05), receptive and expressive language skills (U=82.5, p>.05), social emotional skills (U=44.5, p>.05), motor skills (U=58.5, p>.05) and daily life skills (U=78, p>.05) posttest scores of children in both experimental and control groups were not significant.

Table 3. Wilcoxon Signed Rank Test results according to pretest-posttest scores of the children in both groups

As it can be seen in Table 3, the differences between the children’s pretest and posttest scores from academic/cognitive skills (z=2.98, p<.05), receptive and expressive language skills (z=3.06, p<.05), social emotional skills (z=3.37, p<.05), motor skills (z=3.19, p<.05) and daily life skills (z=2.80, p<.05) were found out to be significant. On the other hand, the differences between the control group children’s pretest and posttest scores from academic/cognitive skills (z=1.21, p>.05) and receptive and expressive language skills (z=1.12, p>.05) were not significant while the differences between the scores from social emotional skills (z=2.11, p<.05), motor skills (z=2.80, p<.05) and daily life skills (z=2.15, p<.05) were found out to be significant. In terms of all the differences found, the posttest scores were found out to be higher.

Discussion

In this study, which investigated the effect of puzzle prototype activities on preschoolers’ developmental areas (cognitive, language, motor, social and emotional development), it can be suggested that children in both groups were similar in terms of the pretest scores taken from Brigance Early Development Inventory II (Table 1). This result indicates that both control and experimental group children’s cognitive, language, motor, social and emotional developmental areas were of same levels before the implementation of the program.

According to the findings, there seemed no significant difference between the posttest scores of both groups (Table 2). This refers to the fact that control and experimental groups’ scores from the measured developmental areas didn’t differentiate. On the other hand, according to the mean ranks, it can be seen that experimental group children’s mean ranks were higher than those of control group children. This addresses the effect of puzzle prototypes leading to such a difference in favour of the experimental group.

The findings revealed that the experimental group children’s Brigance Early Development Inventory II pretest mean scores differed significantly from the posttest scores (Table 3). These differences found at cognitive, language, social-emotional and motor skills areas were likely to be caused by effect of the puzzle prototypes.

The results presented in both Table 2 and Table 3 indicates a significant increase in the scores at all developmental areas of the children participated in the puzzle implementation program. In contrast, control group children yielded significant differences at only three of the developmental areas (social emotional skills, motor skills...
and daily life skills). This finding may indicate that puzzle prototype implementation provides a significant contribution for the development of children.

Demiral (1987) defines educational toys as handy toys enabling children’s development of some concepts and learning by playing as well as making a great contribution to their cognitive development. In this regards, puzzles, which are categorized as educational toys, support learning by playing and at the same time help to improve children’s certain skills such as perception, remembering, analysis, exploration, comparison, relating, finding out the similarities and details, concentrating on the details, making visual distinctions, envisioning, problem solving, critical thinking, part-whole relationship, concentration and observation (Dodge, Colker & Heroman, 2002; Owen, Blakemore & Centers, 2005; Sull, 2006). Group work puzzles allow children interact with each other and give them opportunities to do the puzzle cooperatively; thus puzzles provide remarkable attainments for their receptive and expressive language development. Children doing the puzzle, joining the similar pieces together or trying to group the puzzle pieces according to their characteristics; ask questions and learn new and different words as they are listening to explanation carefully. These experiences help children develop age-appropriate vocabulary, start making grammatical sentences, express themselves in a fluent and meaningful way (Öğüz, Tezcan, Tür & Demiral, 1992; Atalay & Aral, 2001; Dodge, Colker & Heroman, 2002). Fox and Saraeho (1990), as a result of their study examining the analysis of 3-5 year old children’s written language puzzles, asserted that children could differentiate the picture and print while suggesting that puzzles supported early literacy skills and language development. On the other hand, puzzles can be useful in underpinning the development of many social skills such as carrying out the activity for a certain time, playing with peers, sharing, helping, cooperation, waiting for their turn and obeying the rules (Kandir & Tezel Şahin, 2011). Children who can express their joy, anger, shock or frustration in a play context are regarded as mentally healthy as well as having necessary skills in expressing their emotions in an appropriate manner at other contexts (Glassy & Romano, 2003; Glover-Gagnon & Nagle, 2004). Isenberg and Quisenberry (2002) stated that the toys addressing children’s motor development were effectual in supporting their fine and gross muscle development together with hand-eye coordination. Daily life skills are the necessary ones in that they are important in adaptation and positive behaviors so as to live independently and have a good appearance as a result of self-care; all of which can be suggested as the effect of educational toys (Dunn & Arbuckle, 2003; Ferrari, Houge & Scheer, 2004). All in all, it can be suggested that puzzle prototypes have a significant effect on fostering children’s cognitive, social-emotional and psychomotor developmental areas.

It is admitted that pre-schoolers show progress in initiativeness, independence, socialization, defending their rights, respect for others’ rights, self-confidence, curiosity and interest in their environment (Gizir, 2002; Kık, Tuğluk & Bay, 2005). In this sense, the participants’ progress in social emotional skills, motor skills and daily life skills seems to be an expected outcome.

Puzzles are effectual educational materials which support children’s cognitive, language, motor, social and emotional developmental areas while fostering their creativity and self-care skills as well as providing learning during playing with them. Therefore, use of puzzles by practitioners and parents to support children’s development and their academic skills is important. In the light of the findings derived from this study, it can be suggested that the teaching with puzzles should be more controlled within a longer time period. Besides, seminars and in-service training sessions regarding the utilization of puzzles as educational toys both at home and at school can be organized. Meanwhile, educational policies can be adopted addressing the use of puzzles as educational materials at early childhood centers.

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