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Examination of children decision making using clues during the logical reasoning process

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Logical reasoning is the process of thinking about a problem and finding the most effective solution. Children's decision-making skills are part of their cognitive development and are also indicative. The purpose of this study was to examine children's decision-making skills using clues in logical reasoning based on various variables. The study was conducted according to the relational screening model. A purposive sampling method was used in the research. The study group consisted of 119 children attending the kindergarten. Big Math observation form developed by Ginsburg et al. (2003) and adapted to Turkish by Çelik (2012) was used as data collection tool. For this purpose, the children were given two sets of Big Math quadruple clue cards. The data of the study were collected in May 2016/2017 academic year. Percentage and frequency values of the obtained data were calculated. In addition, Mann-Whitney-U test and Kruskal-Wallis test analysis were conducted to measure the differences between groups and the relationships between variables. The results of the research showed that there was no significant difference in the decision making skills of children using logical reasoning clues according to gender. However, it was found that there was a significant difference between the variables of decision making using clues and parents' educational level, and parental occupation and family's economic level.

Key words: Logical reasoning, decision making, child.

INTRODUCTION

Logical inquiry is the process of thinking to achieve a rational result. During this process, factors such as time, investment, physic and/or mathematical rules, ethics, social and religional beliefs are taken into consideration (Ergül, 2014). Children begin to make logical reasoning before they begin school. However, their abilities are rather limited. This is due to the fact that the logical reasoning of the children in this period is based on their own world knowledge and experiences, and are under the influence of their self-centered considerations. As knowledge and experience increase, the ability of logical reasoning also evolves (Clements and Sarama, 2007). However, they often encounter problems that need to be solved in this process. One of the problems that children solve by making logical reasoning is decision making. When the ability to make decisions in children is examined as a process, it appears to be a part of cognitive development, because it is necessary to have

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good thinking ability in the decision making process. According to Piaget (1985), children can have good thinking ability that enables them to perform more complex mental operations during the concrete operations period (ages 7 to 11).

Children have the ability to make mental decisions right from a very young age. For example, a 6 to 9 month old baby may consider pulling back a blanket to reach a toy which he or she otherwise cannot reach (Clements and Sarama, 2007). Children between the ages of 3 and 6 can make mental decisions about their behavior. They have the ability to monitor and intensively observe the events taking place around them (Epstein, 2003; Duman, 2016). According to Fawcett and Markson (2010), children can recognize other people's preferences from the age of three, determine whether they match their own preferences, and use this knowledge to make their own decisions (Ergül, 2014). In order for children to be able to make logical reasoning they need to understand what is expected of them (Clements and Sarama, 2007). Therefore, educational activities appropriate to their developmental characteristics and individual needs should be applied for the development of decision-making skills by making logical reasoning of children. Mathematics is one of the activities that children use most intensively in their logical reasoning. This is because all the rules and operations in mathematics are based on logical reasoning. Children are exposed to mathematics right from birth and basic mathematical information begins in infancy and develops in bounds in the first 5 years of life. Because mathematical skills start to develop in early years, providing a rich stimulating environment especially for infants is important. The first surrounding that children are usually exposed to is the home environment. The results of the research show that the frequency and variety of practices that families do for mathematical development in the home environment has the positive effect of supporting mathematical development in children (Starkey et al., 2004; Young and Loveridge, 2004). In the school, it is considered important for the educator to create a learning environment based on social motivation and to develop cognitive behaviors. Teachers scaffold children’s learning by providing hints, offering a range of answers, and encouraging children to use additional resources. These strategies help children understand the difference between guessing and knowing and realize that guessing requires testing. The ability to distinguish when there is and is not enough evidence to draw conclusions is fundamental to good problem solving (Whittaker, 2014).

Teachers need to use the language of mathematics and provide environments where children can work together, discuss, and take risks. In addition, teachers should create classroom environments that offer freedom and respect for different approaches to problem solving so that children can make decisions by mathematical reasoning (Kirova and Bhargava, 2002; Ginsburg et al., 2003; Greenes et al., 2004; Jackman, 2005).

This study examines the decision-making skills of pre-school children by making logical reasoning. Studies that examine children's decision-making skills often include primary and secondary education students. These studies have focused on the professional decision-making processes and vocational guidance issues of children (Kesici, 2002; Candangil, 2005; Davey, 2010; Huber, 2003; Tatlılıoğlu, 2010). When the researches are examined, it is seen that there is not enough study on logical reasoning and decision making skills in preschool period. Therefore, this research is important because it examines decision making skills by making logical reasoning in children in the pre-school education period.

Purpose of the research

This study was conducted in order to examine children's decision making by using clues in logical reasoning in terms of various variables, with the general aim of the research, the level of children's ability to use their clues in logical reasoning, and the questions: whether there is a difference between the genders, income levels of the families, education levels of the parents, and professions of the parents were asked.

METHODOLOGY

Research model

The model of the research is the descriptive relational screening model from quantitative research. The relational screening model aims to determine the presence of covariance and/or degree of it between two or more variables (Karasar, 2005). Within the content of this study, decision-making abilities of children participating in the study were determined using Big Math clue cards and an observation form.

Research sample

The universe of the work consists of kindergartens attached to the Ministry of National Education in the city center of Düzce and 60 to 72 month old children attending kindergartens of primary schools.

Sampling

The research sample consisted of 119 children from the 11 selected kindergartens. "Convenient sampling" was used in determining the sample. In this method, the researcher can chose the subjects based on their convenient accessibility and proximity to the researcher (Yıldırım and Şimşek, 2005). For this reason, the researcher chose schools that had easy access. 55.5% of the children participating in the study were boys and 45.5% were girls. 44.5% of the mothers of these children were primary and secondary school graduates, 27.7% were high school and 27.7% were university graduates. 43% of the fathers were university graduates and 29% were high school graduates. 56% of the mothers were housewives, 36% of the fathers were civil servants. 32% of the families had very good economic level and 23% had low economic level.

Data collection tools

In the research, in order to collect general information about children and their families, a "General Information Form" was used. The observation form prepared for children aged 60 to 72 months to make decisions by using clues in logical reasoning, developed by Ginsburg et al. (2003) and adapted by Çelik (2012) and the material consisting of two sets of quadruple clue cards were used.

General information form

The sampling included questions about the gender, parent's education status, and parent's occupation.

Observation form

The Big Math observation form was developed with the aim of measuring decision-making abilities by using clues in logical reasoning of children aged 60 to 72 months (Ginsburg et al., 2003). This observation form consisted of questions that 'carefully examine the elements of each card in a set', 'understand the elements of each card', and 'understand and use the clues'. Observed cases were given 1 point when the answer was 'yes' and 0 points when the answer was 'no'. One boy and one girl were chosen for an inter-observer reliability measures. Same children were observed independently by two researchers and their reliability score was 0.90. The researcher completed the observations by herself and the reliability coefficient of the observations made in this study (KR20) was found to be 0.80.

Clue cards

There were quadruple pictures in each set of the clue cards that were prepared for children's ability to make decisions using clues in logical reasoning. The picture of a kite was used in one set of clue cards while picture of another kite was used in another set. These sets included three clues in order to deliver the answer.

Set 1: The following geometric shapes with varying numbers were used in the quadruple clue card with a kite which was numbered from 1 to 4: First card: two triangles, two squares, one circle; Second card: two squares, one triangle, one circle; Third card: two squares, two triangles, two circles; and Fourth card: one square, two triangles, one circle.

Set 2: The following geometric shapes with varying numbers and sizes were used in the quadruple clue card with a blanket which was numbered from 1 to 4: First card: two large circles, three small squares; Second card: two large squares, four triangles, three small squares; Third card: two large squares, two triangles, three small squares; Fourth card: two large squares, two triangles, four small circles.

Collection of data and analysis of data

The drama work was done with the children before the researcher started to collect data and the children were accustomed to the researcher. The researcher sat next to the child and placed the clue cards in front of the child, ordered from 1 to 4. The application was made individually with each child in a quiet center in the class. Before the researcher began to practice, he/she started the interviews by saying to the children, "Now we will play a game with you". Children were asked "What are these?" After the response of the "Kite" was received, "Yes they are kites. One of them is Kerem's kite. I will give you clues to help you decide which kite belongs to Kerem. The first clue is that Kerem's kite has two squares; now which of these can be Kerem's kite?" was asked. After each child had given an answer, he/she was asked to close the picture that does not belong to Kerem according to this clue. The children were given three clues, respectively, and every time he/she was asked to close the picture that did not fit the clue. The last opened kite card was Kerem's kite. Children's answers were not intervened in any way. The same application was made for Clue Card 2. When the application was made, the children were observed and the assessments were recorded on a numbered observation form with the names for each child.

The data collected in the study were found not to be normally distributed in the analysis performed. Percentage and frequency values of the data obtained from the observation evaluation results were calculated. Statistical analysis was also performed with the Mann-Whitney-U test and Kruskal-Wallis test.

FINDINGS

When the results of the observation evaluation were examined in Table 1, it was seen that 95.8% of the children had g1 "looking carefully at each elements' member in a set" observation material. Children had ga1 "recognizes and identifies each card's elements" observation in the ratio of 92.4% and ga2 "counts elements correctly" observation in the ratio of 91.6%. However, they had 58.8% of the gb1 "remembers clues" observation and 57.1% of the gb2 "understands the meaning of the clues" observation.

In Table 2, it is seen that there was no significant difference in children using the clues in decision making by logical reasoning according to gender ($U=1642.500$, $p> 0.05$).

When Table 3 is examined, it is clear that there was a difference in children using the clues in decision making by logical reasoning according to family income ($\chi^2(4)=72.02$, $p<0.05$). According to the results of the Mann Whitney U test to determine in which income levels there were differences, children of the families with middle, high and very high income levels had positively significant difference than the children of families with low and very low income levels and children of families with very high and high income levels had positively significant difference than the children of families with medium income levels.

In Table 4, it is evident that there was a difference in children using the clues in decision making by logical reasoning according to parental education status ($\chi^2(2)=22.08$, $\chi^2(2)=24.22$ $p<0.05$). According to the results of the Mann-Whitney-U test, mothers who are high school and university graduated mothers had positively significant difference than the children of the mothers of primary and secondary school graduates and the children of fathers who were university graduates had positively significant difference than the children of the fathers who were primary and secondary school and high school graduates.

When Table 5 is examined, it is again clear that there

Table 1. Results of observation evaluation.

Items	Yes		No		Total	
	f	%	f	%	f	%
g1	114	95.8	5	4.2	119	100.0
ga1	110	92.4	9	7.6	119	100.0
ga2	109	91.6	10	8.4	119	100.0
gb1	70	58.8	49	41.2	119	100.0
gb2	68	57.1	51	42.9	119	100.0

Table 2. Results of the Mann-Whitney-U test according to gender in children's use of clues in decision-making by making logical reasoning.

Group	n	Order average	Total order	U	p
Girl	53	57.99	3073.50	1642.500	0.519
Boy	66	61.61	4066.50	-	-
Total	119	-	-	-	-

p>0.05.

Table 3. Results of the Kruskal-Wallis test according to family income in children's use of clues in decision-making by making logical reasoning.

Level	n	Order Avr.	sd	χ^2	p	Significant difference
1.Very Low	12	17.63	4	72.02	0.000	1-3, 1-4, 1-5, 2-3, 2-4, 2-5, 3-4, 3-5
2.Low	27	34.57	-	-	-	
3.Middle	25	58.30	-	-	-	
4.Good	17	82.26	-	-	-	
5.Very Good	38	82.61	-	-	-	
Total	119	-	-	-	-	

P<0.05.

Table 4. Results of the Kruskal-Wallis test according to parental education status in children's use of clues in decision-making by making logical reasoning.

Parameter	Level	n	Order Avr.	sd	χ^2	p	Significant difference
Mother	1.Primary and secondary school	53	46.26	2	22.08	0.000	1-2, 1-3
	2.High school	33	64.89	-	-	-	
	3.University	33	77.17	-	-	-	
	Total	119	-	-	-	-	
Father	1.Primary and secondary school	33	42.62	2	24.22	0.000	1-3, 2-3
	2.High school	35	54.51	-	-	-	
	3.University	51	75.01	-	-	-	
	Total	119	-	-	-	-	

P<0.05.

was a difference in children using the clues in decision making by logical reasoning according to parental occupation status [$\chi^2(4)=19.41$, $\chi^2(4)=19.96$ $p<0.05$]. According to the results of the Mann Whitney U test to

Table 5. Results of the Kruskal-Wallis test according to parental occupation status in children's use of clues in decision-making by making logical reasoning.

Parameter	Occupation	n	Order Avr.	sd	χ^2	p	Significant difference
Mother	1.Housewife	67	51.23	4	19.41	0.001	1-2
	2.Civil servant	26	81.27	-	-	-	
	3.Laborer	15	58.27	-	-	-	
	4.Independent business	6	58.00	-	-	-	
	5.Other	5	74.50	-	-	-	
	Total	119	-	-	-	-	
Father	1.Not working	2	58.00	4	14.96	0.005	2-3
	2.Civil servant	43	72.98	-	-	-	
	3.Laborer	42	49.48	-	-	-	
	4.Independent business	14	48.46	-	-		
	5.Other	18	62.75	-	-		
	Total	119	-	-	-		

P<0.05.

determine which occupation groups were involved in this differentiation, the children of civil servant mothers were found to be positively different from the children of the mothers who were housewives on a significant level and the children of the fathers who were the civil servants were positively different from the children of the fathers who were laborers in significant level.

DISCUSSION

When the results of the observation evaluation were examined, it was found that the children knew and counted the circle, square (large-small), triangle geometric shapes found in the cards in set 1 and set 2 at high rate (95.8%). In this work, it was important that they could identify and count geometric shapes as preconditioning skills so that they could make decisions using clues. Observation evaluation results indicate that this condition was provided for the study. However, this rate dropped in observations that evaluated the understanding and recalling in logical reasoning using clues in decision making. Children need to understand what they wanted to do, to be able to make decisions by performing logical reasoning (Clements and Sarama, 2007). It was observed that 57.1% of the children who participated in the study had this and that they could use the clues correctly to make decision. It appears that there was no significant difference between girls and boys when children use clues to make decisions by logical reasoning. This result overlaps with other research results. Mata et al. (2013) have also found that there is no difference between boys and girls in their studies evaluating effective decision-making in Brazilian children aged 3 to 6 years. Klein et al. (2010) investigated the effects of gender on pre-school children's verbal, spatial, mathematical skills and teacher-child mathematical interactions by video-taping children, while they were playing mathematical reasoning games. Mathematical, spatial and verbal skills of children and mathematical communication of teachers were evaluated. There was no significant difference between boys and girls based on their verbal, spatial, and mathematical achievement.

It seems that children's use of clues in decision making by logical inquiry differs according to their family's income. It has been found that children of families with very low and low incomes had difficulty in using clues in decision making by logical reasoning and that the levels of observation evaluation were low. One of the most important factors affecting income level is the occupied profession. The profession is generally achieved as a result of education. In this context, in the analysis of the educational status and occupation of the children's parents and the results of the observation evaluations found that there was a significant difference in favor of the children of the families who had high educational status and who were civil servants. The educational level of the family affects the aspects and attitudes toward mathematics and the quality of the mathematical activities offered to the child at home (Clements and Sarama, 2007; Musun-Miller and Blevins-Knabe, 1998). In the study of mathematical achievements of children attending kindergarten by Çelik (2015), the educational levels of parents and the level of income of their families were found to affect children's mathematical achievements. One observes that children at the age of 5 to 6 years with low income levels cannot even answer simple arithmetic problems, but most children with middle-income parents can easily answer (Griffin et al., 1994; Clements and Sarama, 2007). In one study, 75% of

children aged 5 to 6 years with middle-income level were found to be able to make inferences about the size of two different figures and to make basic addition mentally but the rate of 7% were found in children with low-income from the same community (Case et al., 1999). Ergül (2014) found that children's reasoning skills differed according to their parents' educational level and children of parents with higher education were more successful in the study conducted with 60 to 74 month old children. Karakaş (1999) found that, in the study of evaluation of 4 and 5th grade children in decision making skills related to problem solving in everyday life, the students in the upper level schools have more positive skills based on the economic environment of the school.

CONFLICT OF INTERESTS

The authors has not declared any conflict of interests.

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