A Study of Pre-School Children's School Readiness Related to Scientific Thinking Skills

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INTRODUCTION

Constant accumulation of knowledge and technological developments of our times make it an imperative for people of all ages to learn scientific thinking methods which constitute foundations of the knowledge accumulation and technological developments. This is essential in terms of both acquiring accumulated knowledge, and producing new knowledge that fit constantly changing conditions. Learning scientific thinking methods is important for pre-school children both to acquire scientific knowledge, and to fit in the environment that is based on scientific knowledge.

As in every field, real life experiences show the way in this field, as well. Children's real life experiences present them those sources that constitute the foundations of scientific thinking (French, 1985a, 1985b; Nelson, 1986). It is highly important that scientific thinking skills, which 21st century men should have, are supported starting from the pre-school period.

Lloyd and Howe (2003) underlined the significance of trying various and untraditional methods regarding scientific thinking of children and problem solving. On the other hand, there have been attempts to develop special programs that are designed to improve scientific thinking of pre-school children in recent years.

When pre-school children and scientific thinking are considered, skills and knowledge of pre-school children should be on the foreground. Children in pre-school period are curious and they use their imagination to guess or draw conclusions, seek answers to their questions and insist on having their questions being answered.

On the basis of this point, with the aim of developing scientific thinking skills in children and support them in this sense, children should be given opportunities to use their senses to make research, satisfy their curiosity, see the cause and effect relationships, bring ideas forward and make guesses while appropriate education environments should be presented to them (Bal, 1993, p. 146).

As it is known, starting primary education is a very important step for pre-school children. The reason for this is the fact that in this period children are introduced with products of scientific thinking in primary education and try to acquire those products. For this reason, developing scientific thinking of pre-school children at first years of primary education is important.

In terms of gaining scientific knowledge during primary education, children's pre-school experiences and qualities of the pre-school that gave them such experiences come to the fore. Tepperman (1998), underlined that success at school, IQ, and success at different levels of life are determined to be higher for children who received high quality pre-school education.

The significance of all the factors that make up a child's environment; such as culture, family, socio-economical status has long been emphasized (Halle and Zaff, 2000).

It has been suggested that a holistic approach that put forward different variables such as family factors, cultural factors and school education together will be investigated in relation to develop scientific thinking (French, 2004). Moving from here, in this study the variables mentioned were investigated.

In other words, relations between scientific thinking skills and experiences of pre-school education were studied in relation to the child's age, gender, socio-economical status.

The purpose of this study is to compare school readiness of children who had pre-school experiences and children without such experiences on the basis of scientific thinking skills. This comparison is held in terms of variables of age, gender, and socio economic status.

The questions of the study in relation to the purpose of the study are as follows:

- **Does pre-school education variable influence primary school readiness of pre-school children in terms of scientific thinking skills?**
- **Does age variable influence primary school readiness of pre-school children in terms of scientific thinking skills?**
- **Does gender variable influence primary school readiness of pre-school children in terms of scientific thinking skills?**
- **Does socio-economical status variable influence primary school readiness of pre-school children in terms of scientific thinking skills?**

METHOD

The Sample of the Study

The study was run according to survey design and is conducted on data collected from a total of 300 children, 180 of whom attend a pre-school, 120 of whom do not attend such a school and their parents. The children are 5.0, 5.5, and 6.0 years old.

The numbers of children in each age group are as follows: 5 years old 101 children (51 girls, 50 boys), 5.5 years old 99 children (49 girls, 50 boys), 6 years old 100 children (50 girls, 50 boys). In sum, 300 children 150 of whom are girls and 150 of whom are boys are participated in the study.

Data Collection Tools

The Questionnaire

The questionnaire consisted of 28 questions. They are about children's attending a pre-school or not, age, gender, and determinants of socio-economic status such as monthly income, additional income, ownership of apartment, number of rooms in the apartment, belongings, number of people living in the apartment, etc.

Scale of School Readiness

The data have been gathered through the subtest of Science which belongs to the "Marmara Scale for Primary School Readiness" that was developed by Unutkan in 2003. The "Marmara Scale for Primary School Readiness" has 5 subtests, namely mathematics, science, sound, drawing and labyrinth studies.

The scale is comprised of 74 questions in total. It has been applied to children individually by the researcher. In this study Science subtest of the whole scale that is made up of 14 questions that evaluate children's scientific thinking skills (2 induction questions, 6 deduction questions, 6 problem solving questions) has been used.

Test-retest correlation (continuity coefficient) for application form r=.93, p< 0.01 has been calculated to be quite high. Internal Consistency Reliability (cronbach alpha) is also high (r=.93 p<.01). As validity study, factor structure of the whole scale has been determined through factor analysis. Internal Consistency Reliability- cronbach alpha - for Science subtest that is used in the study is also quite high (r=.86 p<.01).
Procedure

The questionnaire was completed by the families. Science subtest of the main scale has been implemented to the children individually by the researcher.

Demographical information that is received from the families through survey form has been compared with data from the scale and differences have been evaluated using t test and variance analysis. Level of significance has been determined to be 0.05 and 0.01 has also been indicated. In order to determine the source of differences LSD test has been used.

RESULTS

Results of statistical analysis are presented below in tables.

Table: 1
Results of t test conducted for scientific thinking skills in terms of school readiness variable

		N	*X*	*SD*	*Df*	*t*	*p*
INDUCTION	With school readiness experience	120	,725	,8297	298	-4,138	p<0,01
	Without school readiness experience	180	1,200	1,0591			
DEDUCTION	With school readiness experience	120	3,366	1,8007	298	-2,559	p<0,01
	Without school readiness experience	180	3,894	1,7158			
PROBLEM SOLVING	With school readiness experience	120	1,766	1,4536	298	-8,391	p<0,01
	Without school readiness experience	180	3,372	1,7273			
TOTAL	With school readiness experience	120	5,858	3,2288	298	-6,78	p<0,01
	Without school readiness experience	180	8,466	3,2825			

According to results of t test conducted for scientific thinking skills in terms of school readiness experience, significant differences were found in all subtests and in total at p<0,01 level (for induction t=4,14, for deduction t=2,56, for problem solving t=8,39, for total score t=6,78).

It can be concluded that children with school readiness experiences have a higher degree of scientific thinking skills.

Table: 2
Results of t test conducted for scientific thinking skills in terms of gender variable

		N	*X*	*SD*	*Df*	*t*	*p*
INDUCTION	Girl	150	1,046	,8301	298	,634	-
	Boy	150	,973	1,1466			
DEDUCTION	Girl	150	3,753	1,7758	298	,686	-
	Boy	150	3,613	1,7600			
PROBLEM SOLVING	Girl	150	2,746	1,8435	298	,160	-
	Boy	150	2,713	1,7659			
TOTAL	Girl	150	7,546	3,4903	298	,610	-
	Boy	150	7,300	3,5136			

According to results of t test conducted for scientific thinking skills in terms of gender there are no significant differences in any subtests or in total.

Table: 3
Arithmetic means, standard deviation values for scientific thinking skills in terms of age variable

		N	*X*	*SD*
INDUCTION	5 years old	101	,7624	,8142
	5,5 years old	99	1,060	,7930
	6 years old	100	1,210	1,2736
	Total	300	1,010	,9999
DEDUCTION	5 years old	101	3,227	1,9384
	5,5 years old	99	3,767	1,4903
	6 years old	100	4,060	1,7513
	Total	300	3,683	1,7663
PROBLEM SOLVING	5 years old	101	2,267	1,8324
	5,5 years old	99	2,868	1,6453
	6 years old	100	3,060	1,8412
	Total	300	2,730	1,8022
TOTAL	5 years old	101	6,257	3,7434
	5,5 years old	99	7,697	2,6590
	6 years old	100	8,330	3,6764
	Total	300	7,423	3,4983

When arithmetic means are evaluated in terms of age variable it can be seen that regarding all skills of scientific thinking, arithmetic means for 5 and 6 year-old children are higher than the others.

According to results of variance analysis conducted for scientific thinking skills in terms of age variable, there is a significant difference in all skills at p<0,01 level (for induction F=5.38, for deduction F=5.94, for problem solving F=5.46, for total score F=9.82).

Table: 4
Results of one way ANOVA for scientific thinking skills in terms of age variable

		Sum of Squares	*Df*	*Square Means*	*F*	*P*
INDUCTION	Within Groups	10,447	2	5,223	5,377	p<0.01
	Between Groups	288,523	297	,971		
	Total	298,970	299			
DEDUCTION	Within Groups	35,858	2	17,929	5,936	p<0.01
	Between Groups	897,059	297	3,020		
	Total	932,917	299			
PROBLEM SOLVING	Within Groups	34,415	2	17,207	5,456	p<0.01
	Between Groups	936,715	297	3,154		
	Total	971,130	299			
TOTAL	Within Groups	226,911	2	113,455	9,817	p<0.01
	Between Groups	3432,326	297	11,557		
	Total	3659,237	299			

As a result of LSD test this difference is found to be between 5.5 and 6 year-old age groups and against 5 year-old age group.

Table: 5
Arithmetic means, standard deviation values for scientific thinking skills in terms of socio-economic status variable

		N	*X*	*SD*
INDUCTION	Lower socio-economic status	120	,8083	,8126
	Medium socio-economic status	120	1,141	1,2112
	Upper socio-economic status	60	1,150	,7988
	Total	300	1,010	,9999
DEDUCTION	Lower socio-economic status	120	3,425	1,7806
	Medium socio-economic status	120	3,916	1,7613
	Upper socio-economic status	60	3,733	1,7060
	Total	300	3,683	1,7663
PROBLEM SOLVING	Lower socio-economic status	120	2,225	1,7074

	Medium socio-economic status	120	2,775	1,8446
	Upper socio-economic status	60	3,650	1,5274
	Total	300	2,730	1,8022
TOTAL	Lower socio-economic status	120	6,458	3,3478
	Medium socio-economic status	120	7,833	3,7085
	Upper socio-economic status	60	8,533	2,8610
	Total	300	7,423	3,4983

When arithmetic mean is calculated in terms of socio-economic status variable, it is concluded that in all skills arithmetic mean of children from families of lower socio-economic status is lower and arithmetic mean of children from families of upper socio-economic status is higher than that of other children.

Table: 6
Results of one way ANOVA for scientific thinking skills in terms of socio-economic status variable

		Sum of Squares	*Df*	*Square Means*	*F*	*P*
INDUCTION	Within Groups	8,137	2	4,068	4,155	p<0,01
	Between Groups	290,833	297	,979		
	Total	298,970	299			
DEDUCTION	Within Groups	14,692	2	7,346	2,376	-
	Between Groups	918,225	297	3,092		
	Total	932,917	299			
PROBLEM SOLVING	Within Groups	81,630	2	40,815	13,628	p<0,01
	Between Groups	889,500	297	2,995		
	Total	971,130	299			
TOTAL	Within Groups	205,845	2	102,923	8,852	p<0,01
	Between Groups	3453,392	297	11,628		
	Total	3659,237	299			

As a result of the variance analysis conducted for socio-economical status variable a significant difference at p<0,01 level is reached at in all skills other than deduction (for induction F=4.15, for deduction F=2.38, for problem solving F=13.63, for total score F=8.85).

LSD test revealed that this difference is between medium and upper socio-economic status groups and against children from lower socio-economic status families.

DISCUSSION

In this research school readiness of children who had school readiness experiences and children without experiences of school readiness were compared on the basis of scientific thinking skills related to age, gender, and socio-economic status.

It was found that children who had school readiness experiences significantly differ from children without experiences of school readiness in terms of induction, deduction, problem solving skills and total score that derived from the scale.

In order to develop scientific thinking in children, Lloyd and Howe (2003) have mentioned the importance of developing different thinking skills that can provide scientific thinking rather than adopting approaches that directly target scientific thinking.

Moving from there and as is proven in this study; it can be assumed that various thinking skills such as induction, deduction, and problem solving contribute to a general scientific thinking skill. On the other hand, the fact that those children who had school readiness experiences are more skilled in scientific thinking demonstrated that scientific thinking is related to education.

In terms of gender, no difference could be detected in scientific thinking skills of children.

The results indicated that scientific thinking skills of children differ according to age. Scientific thinking skills of 5 year-old children are insufficient compared to that of 5.5 and 6 year-olds. It can be concluded that scientific thinking skills improve with age. The reasons of this can be the increase in children's experiences and their mental maturing with age.

There was no significant difference in terms of deduction related to socio-economic status. In terms of induction, problem solving and total score from scale, there is a significant difference against children that have lower socio-economic status. According to this, children that have lower socio-economic status are not ready enough for primary education in terms of scientific thinking skills and they are disadvantageous compared to other children.

For this reason, especially for children that have lower socio-economic status, it is very important to receive pre-school education. As it is known, when compared to children from families that have upper socio-economic status, children from families that have lower socio-economic status are disadvantageous in terms of their development (Unutkan, 2003; Zill, 1995).

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