

## Science Content Knowledge of 5-6 Year Old Preschool Children

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### ABSTRACT

The present study is a descriptive research in the scanning model. In the present study is research conducted to determine five to six-year-old children's knowledge of science content, study group constitutes of 360 children attending preschool educational institutions in Burdur city center and their parents and teachers. In the study, Science Content Standards Scale (SCSS) Trial Form developed by Taştepe (2012) was used. SCSS consists of a total 31 items and three subscales including Life Science, Physical Sciences, Earth and Space Sciences processing areas. SCSS-Trial Form was filled at the end of May 2015 by group teachers giving children training throughout the whole academic year. Group score differences were analyzed with one-way analysis of variance (ANOVA) technique. Difference among groups is tested using Scheffe and Tamhane techniques. While statistically significant differences are observed among children's scores obtained from SCSS total and sub-dimensions according to age and duration of preschool education, and all sub-dimensions as per number of siblings, there are not any statistically significant differences among children's scores total and sub-dimension according to gender and mothers and fathers' age. While difference among children's scores obtained from physical sciences, earth and space sciences is observed in favor of firstborn, no differences in life sciences and total score are not determined. There is a statistically significant difference between children's scores in physical and life sciences sub-dimensions as per mothers and father' status of education, and physical sciences sub-dimensions as per mothers' occupational group but there are not any significant differences determined in as per father' occupational group.

### KEYWORDS

Preschool, kindergarten,  
science content knowledge,  
teacher and parents

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### Introduction

Early childhood period establishes framework of human life. First years of life are of vital importance for subsequent outcomes. Small children's intrinsic learning desire are either suppressed or supported by early experiences. During this period, qualified education towards all areas of development will both create school awareness and be determinative for the future academic and social success.

Science and science activities have an increasing significance in preschool education program. When love of science, also scientific thinking and expression skills are developed among preschool children, they will get a chance to learn

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science concepts, methods and attitudes at a young age. This will create a strong foundation among these children for science, mathematics, reading-writing in future.

At preschool level, science education allows each child to notice meaning of concepts and acquire these concepts, to observe relationships and to discover new ways to understand his/her surrounding, to understand the cycle in nature and how people, nature and society affect each other, to develop interest, to create relationships in nature and understanding of science including simple chemical processes and physical phenomena, also knowledge of animals and plants, and to develop skills of research, differentiation, scientific discussion, asking questions about science and saving (Lpfo '98 revised 2010, pp. 10 cited, Andersson and Gullberg, 2014, pp. 277). Today, science education is based on research, and research processes include asking questions, reading and researching for a purpose, making predictions and suggesting solutions, collecting information and interpreting (Morrison, 2009, p. 360). According to American state and national standards, small children may show different cognitive skill performances such as research, questioning, asking questions and making predictions that are essential to scientific thinking and learning (Kuhn and Pearsall, 2000; Metz, 1997; National Research Council [NRC], 1996; Opfer and Siegler, 2004; Zimmerman, 2000).

In preschool education, interest in science education is supported by not only developmental theories but also research findings (cited, Guo, Piasta and Bowles, 2015, p. 125-126) emphasizing that preschool children are biologically ready to learn about the world and science concepts, and motivated to research (Eshach and Fried, 2005; French, 2004; Gallenstein, 2003; Gelman, 1979,1990) and these children show powerful cognitive competencies in scientific research field (e.g., Kuhn and Pearsall, 2000).

Science education is important during preschool period because science is an ideal tool for developing a request for questioning about the world among children. While searching science, children learn to read in new contexts together with acquisition of verbal and written language. Science teaches children to value life and interconnected diversity in life. When children acquire information about the nature, they tend to protect and respect the world and its natural resources (Morrison, 2009).

Content fields within American Early Science Content Standards are realized in three basic operation fields such as physical sciences, life sciences, earth and space sciences (Butzow and Butzow, 2000; Driscoll, 2003; Kloos et al., 2012; Martin, 2001; Ohio Department of Education, 2011). Physical sciences are associated with matter and include science of physics and chemistry such as properties of matter, states of matter, change and mixture of matter, classification of object and materials, balance, weight, energy, movement of objects, heat, light-shadow and sound (Bozkurt and Olgun, 2005; Brewer, 2001; Charlesworth, Lind and Fleedge, 2003; Davies and Howe, 2003; Franklin, Lamana and Van Thiel, 2003; Lind, 2005; Morrison, 2009; Rakow and Bell, 1998; Worth and Grollman, 2003). According to Marxen (1995), physical activities suitable for small children should have criteria of creating own actions for children, changing actions, transforming these actions, direct reaction of object and such reaction being observable (cited, Brewer, 2001, p. 370).

According to Charlesworth et al. (2003), teachers in preschool classes are not confident about themselves in terms of physical education activities, and they consider physical very complicated for both themselves and children. That is why physical science activities are neglected. Kallery and Psillos (2001) studied preschool teachers' knowledge on physical phenomenon and found out that teachers have insufficient knowledge on subject and content and they are unable to answer children's questions about complex natural phenomenon with a scientific method. Uysal (2007), in a study conducted with twenty preschool teachers, found out that teachers care about science activities, they gave more place to adverse concepts in these activities, but they do not make enough effort to bring in concepts related to physical sciences that are difficult to teach such as sound, electricity, light. Similarly, Aykut (2006) also revealed that, while preschool teachers feel themselves sufficient in biology subjects, they feel themselves inadequate in physical sciences and earth science subjects. According to According to Brown, Brown, Barnot and Nelson (2014), the majority of preschool teachers are women, and they tend to have more negative attitudes towards physical sciences compared to men.

Osborn, Simon and Collins (2003) also emphasize that physical sciences containing chemistry and physics are often least popular sciences. Pre-service teachers have lack of confidence and negative attitudes towards potential training of these sciences (Brigido, Bermejo and Mellado, 2012; Johnston and Ahtee, 2006; Tosun, 2000; Wenner, 1993; Yılmaz Tüzün, 2008). A number of researchers have pointed out that this situation is due to the lack of understanding in scientific thinking or negative past experiences in school (Ahtee and Johnston, 2006; Harlen and Jelly, 1997; Johnston and Ahtee, 2006).

Another general science content field includes life sciences. Life sciences contain content information about physical properties of human, animal and plants such as parts, color, shape, texture and all other features, classification of plants and animals, life cycle of organisms, inheritance, relationship between organisms and environment (Charlesworth et al. 2003; Cheadle, 2009; Franklin, Lamana and Van Thiel, 2003; Jackman, 2011; Martin, 2001; Martin, Sexton, Franklin, Gerlovich and McElroy, 2014; Morrison, 2009; Rakow and Bell, 1998, Worth and Grollman, 2003; Wortham, 2006). Children realize relationship among people, plants, animal, insects, water, soil, sun, air and heat, and they discover not only themselves but also the world with activities towards environmental experiences and life sciences (Eliason and Jenkins, 2008).

Concepts of earth and space science consist of meteorology and astronomy. Geology is the science of studying the world, rocks, and shells; meteorology is the science of studying meteorology, air and atmosphere; astronomy is the science studying the universe beyond the earth's atmosphere including the Sun, the Moon, planets, and stars (Brewer, 2001; Franklin, Lamana and Van Thiel, 2003; Eliason and Jenkins, 2011; Martin et al., 2014). Understanding the structure, history, climate, weather conditions of the earth and the solar system requires understanding of many concepts from life and physical sciences (Worth and Grollman, 2003). The science of ecology studying interactions between alive and lifeless creatures and with the nature, and emerging results are also discussed within the scopes of life sciences, and earth and space sciences. Concepts contained in science process fields are provided to three to six-year-old children in preschool education institutions using basic scientific research skills such as

observation, comparison, scientific communication, classification, measurement, prediction, data collection and recording.

As in preschool daily activities and event programs, science activities and science training programs are also established over appropriate science content and the understanding of what children know and what and how they can learn as emphasized in Piaget's theory. Education standards are also considered as guides determining what all children from different religion, language, race, socio-economic status and culture can and should do in common during the learning process. According to Kentucky Early Childhood Standards (2009, 2010, 2013), the standard is a general statement that describes knowledge and skills what a child should know and what a child can do. Standards in recent years have become a widely accepted part of early childhood education. NAEYC (2003) issued task statements about what high quality early childhood standards should contain (Essa, 2011, p.164).

According to NAEYC and NAECS/SDE (2002), effective early learning standards require classroom applications as much as learning strategies to support positive development and learning and that are related to small children's interest and skills. Assessment tools for small children's progresses must be clearly related to significant learning presented in standards; technically, these tools should be developmentally and culturally valid and offer comprehensive and useful information. According to standards, information acquired from assessment of small children's progress should be used for the benefit of children. Evaluation and monitoring systems should be used to improve the application and service, and they should not be used to rate, classify and punishment children. It is necessary to establish standards based on research and environments in which enough resources and standards can be effectively applied for high quality early childhood programs. Early learning standards will have the most positive impact thanks to the support provided to families and communication based on respect established with families being key partners in teaching small children.

Bowman (2006, p.1-2) discusses standards in four groups:

- "Program Standards" organized to establish an organizational structure for programs;
- "Content Standards" defining information, concepts and skills that can be taught at every educational and age level and that contain academic knowledge as much as physical and social skills, in a way guiding the program;
- "Learning or Performance Standards" providing the detailed table of what children can do and should learn (learning/performance standards do not mean that all children should show success contemporary and in the same method but mean that we are aware of what to teach to children. Since learning/performance can be evaluated, it is important for teachers and families to know about outcomes they need.)
- "Professional Development Standards" defining knowledge and skills required by teachers for being effective. These standards are generally dependent on accreditation, and they determine organizational structures of an educational institution as much as learning purposes and targets based on frequently assessment.

As in general early childhood learning standards, defining quality in science education, determining what the content should be and developing the content,

also assessing developed standards are of importance not only in upper level classes but also in preschool classes.

Analyzing studies conducted outside Turkey towards what the content of science activities should be during preschool period, it can be seen that some of these standards put developmental features to forefront and some of these put the content to forefront (ECAP Report/Cesarone, 2007; Illinois, 2002; Kentucky, 2002, Revision 2009, 2013; Massachusetts, 2013; NAEYC and NAECS/SDE, 2002; NRC, 1996; Ohio, 2011; Pensilvania, 2009; PRE-K, 2004; South Carolina, 2009).

Analyzing Preschool Education Programs by Ministry of Education (1994, 2002, 2006, 2013) in Turkey, it can be seen that science activities as in all activities are based on children's developmental characteristics, at the same time, the weight is given to bring in skills of scientific research process. In programs of the Ministry of national education, content standards required for three to six-year-old children, namely skills and competencies related to themes and concepts towards science are not defined clearly. By determining science content standards developmentally suitable for preschool period, it will be possible to review these standards according to characteristics of residential areas and their cultural structure and requirements, and to assess children's level of having these standards.

Illinois Early Science Learning Standards (2002) express skills that children should have as follows:

To carry out experiments and as research questions and understand processes of technological design and scientific research processes to solve problems; To know scientific research processes, concepts and principles and apply them; To use senses for analyzing and researching natural phenomena and materials; To collect, describe and record information; To know and practice technological design processes, concepts and principles; To use scientific tools such as magnifying glass, thermometer and scales; To be familiar with the use of tools technological; To understand connections, basic concepts and principles of life sciences, physical sciences and earth and space sciences; To know and practice concepts explaining how living things function, their adaptation and change; To know and classify the living things in his/her surrounding; To show awareness of changes emerging in them and in their surroundings; To know and practice concepts that describe how living things interact with their surrounding; To compare and explain basic requirements of living things; To know and practice concepts that explain characteristics of matter and energy, and interactions between them; To make comparisons between observed objects; To know and practice concepts that describe force and movement, and that explain principles; To describe effects of forces in nature such as wind, gravity and magnetism; To know and practice concepts that explain characteristics of the earth and its processes and sources; To use general words about weather condition such as rainy, snowy, sunny and windy; To participate in recycling around them; To know and practice concepts that explain the structure and layout of the universe and the place of the earth in the universe; To define general concepts about day/night and seasons; To understand relationships between science, technology and society in historical and contemporary contexts; To know and practice accepted applications of science; To begin understanding basic safety applications; To know and practice concepts explaining the interaction between science, technology and

society; To express their curiosities about their worlds and ask questions; to become aware of technology and how it affects their lives.

The aim of Kentucky Early Childhood Science Standards (2002, revision, 2009, 2010, 2013) is to offer scientific thinking and working methods. Criteria of the standard require that children are able to describe characteristics and similarities of objects with manipulation; To make researches on simple scientific concepts/describe objects that cause a change on other objects or affect them; To use standard and nonstandard tools for researching the nature; To collect, record and describe information in different ways/collect objects with similarities and describe these objects as per their characteristics; To make predictions based on past experiences and validate them; To understand the world they live in, to recognize differences among past, present and future events/to remember recent information, to analyze differences between past and present by comparing the present with the past and to correctly order a limited series of events.

In brief, science content standards expect children to develop knowledge of basic science concepts and research skills (NRC, 1996, 2000). Standards have importance not only for children but also for teachers, and they guide teachers in choosing interesting experiences that contain activities and manipulation suitable for children's developmental level (Bosse, Jacobs and Anderson, 2009, p.12). Watters and Diezmann (1998) have expressed that standards define a rich science program based on constructivist theory with a view to create a social learning environment suitable for science learning for 5 to 8-year-old children, they consider teacher roles and strategic actions aiming at reaching theoretical targets, and they offer a proof that promotes critical thinking and knowledge production in a class environment encouraging children to authentic scientific application.

According to NAEYC (2002), it is necessary for research-based standards and high-quality programs to establish environments in which standards can be implemented in an effective way, to procure adequate resources, and at the same time to expand professional development of preschool managers and teachers in a way to implement learning standards effectively and gain knowledge and skills.

In studies, it has been revealed that preschool teachers do not consider themselves sufficient in science education and what science content should be, they do not give suitable answers for children's level, they lack subject knowledge and have wrong beliefs, they are limited in understanding science concepts and transferring these concepts to children, they are insufficient in transforming children's question to scientific questions that children can research (Kallery Psillos, 2001) and they lack science subject field knowledge (Çınar, 2013). With the help of science content standards to be developed according to preschool children's culture, socio-economic and developmental characteristics, it will be possible to assist teachers in feeling themselves qualified in science education and in the science content knowledge to offer children.

In recent years, science education standards began to be determined newly and in limited sense by researchers in Turkey. In Turkey, there is only Science Content Standards Scale Trial Form by Taştepe (2012) available towards determining science content standards. As a result of validity and reliability study, this form has not been used by any researchers with a view to examine children's level of having science standards from the point of different variables.

Outside Turkey, on the other hand, Saçkes (2014) conducted a study on 3305 preschool teachers in the United States towards analyzing the frequency of



preschool teachers in teaching standard based science concepts and factors affecting this frequency. Results revealed that teachers' frequency of teaching certain science concepts (e.g., earth and space, life and physical science) and number of science courses were affected from children's perception of learning capacity and availability of teaching materials related to science in preschool classes. On the other hand, findings have shown that teachers' perception of control on the program and their teaching experiences are not effective on their frequency of teaching science concepts in preschool classes.

In Turkey, there is a need for creating science content standards because, analyzing conducted studies, preschool teachers have some problems in selection of concepts during science activities, constructing activities (Akkaya, 2007; Karaer and Kösterelioğlu, 2005; Özbey, 2006), in terms of using different methods in activities and material preparation and on the use of materials (Karamustafaoğlu and Kandaz, 2006). As emphasized by Johnson (1999), science is often neglected in early childhood classes. Perhaps reason for this situation is the fact that science is conceived and presented in an excessive formal way, it is excessively abstract and theoretical, in other words, it is highly difficult for small children to learn (Wilson, 2002). Teachers generally work on subjects they feel confident, and they lack confidence in bringing children in science concepts that are often abstract. Hope, Schachter and Wasik (2013) express that preschool teacher do not offer high-quality science experiences for children since they have low self-efficacy and due to lack of educational sources. Also in the work of Rice and Roychoudhury (1994), it has been determined that some teachers considered successful in realizing science activities in the classroom avoid subjects that they have difficulty. Downing and Filer (1999) express that science concepts are limited with subjects for which teachers feel safe.

Level of confidence in science disciplines mainly vary. According to some studies, while pre service teachers do not feel safe in terms of future science education, preschool teachers feel more safe in terms of teaching life sciences rather than physical sciences (Brigido et al., 2012; Murphy, Neil and Beggs, 2007; Yates and Goodrum, 1990; Yılmaz Tüzün, 2008). Osborne et al. (2003, p.1064), in their study, found that the most important factor affecting student's attitude towards science is gender.

Piasta, Pelatti and Miller (2014), in a study conducted in 65 preschool classes, found that type and amount of science and mathematics opportunities offered to children by preschool teachers in their classrooms are associated with these teachers' service duration, education levels and children's socio-economic status. Besides, in the study, it was emphasized that, as specified in professional and state/national standards, all teachers providing science and mathematics experiences to preschool children may require additional professional development towards increasing their application of science and mathematics learning opportunities and their knowledge on this subject. One of findings in the study conducted by Saçkes, Trundle and Bell (2013) is that kindergarten and preschool teachers' science content and pedagogical content knowledge should be improved immediately.

Andersson and Gullberg (2014, p. 294) refer to four skills that preschool teachers can improve to expand their pedagogical content information in teacher training and in-service courses and to allow children make use of science education; such as using previous experiences by children and caring to do this,

catching unexpected things that arise in a snapshot, asking questions that promote and encourage children to research, and listening to children and their explanations.

Investigating the field literature, only one study is found that directly includes science content knowledge required for preschool children and analysis of this knowledge in terms of various variables. Guo et al. (2015), in their study, examined the relationship between preschool children's science content knowledge and the family's socio-economic level, gender of children, cognitive skills, mathematics and language abilities. The researchers have established a science content knowledge scale thanks to additional items to an existing informal assessment that contains science content called Core Knowledge Preschool Assessment Tool (CK-PAT). Most of scale items reflect items that include the content within Ohio (Ohio Department of Education, 2007) early learning content standards. Reliability coefficient of the scale was found as .94. Also in the study, Block Designing subtest consisting of 20 items with a view to measure cognitive skill/to assess children's conceptual organization and non-verbal reasoning skills as preschool and primary school version of the Intelligence Scale-III prepared by Wechsler (2002) assessing children's cognitive abilities was used. Reliability coefficient of the scale was found as .79. To measure children's mathematics skills, 35-item Woodcock-Johnson Achievement Test-III based on causation and problem solving was used. Besides, children's language skills were determined using the Receptive One-Word Picture Vocabulary Test (Brownell, 2000) normed for 2-10-year-old group. In the study, reliability coefficient of the scale was found as .98. As a result of the research, while no differences were found in children's science content knowledge as per gender, a significant difference was identified as per mother's educational level in favor of bachelor's degree graduate mothers. Concerning this emerging result, it is interpreted that mothers at postgraduate level offer fewer learning opportunities compared to bachelor's degree graduate mothers due to more working hours. A significant relationship was found between children's science content knowledge and family's socioeconomic level, children's cognitive skills, their mathematics and language skills.

This finding by Guo et al. (2015) has supported other research findings (Lee and Burkhem, 2002; Magnuson, Sexton, Davis-Kean and Huston, 2009) in which children of mothers with higher level of education show higher academic success.

In the study by Buldu, Buldu and Buldu (2014) conducted with a view to assess the quality of science education in kindergarten, primary school, second and third grades, 20 primary school and 80 teachers working in these schools in Ankara formed the sample. As a result of the research conducted using qualitative research design, it is revealed that science topics are generally given wide place both in state and private school curriculum, teachers providing education in these classes have a weak science education background, there are not any significant learning spaces spared for science education in classes, teachers use various teaching methods and learning techniques while teaching science, teachers frequently use direct presentation and question-answer methods, and teachers consider assessment of learning as equal to application of test. An important finding of the research is the fact that science activities in first grade classes of primary school is 40 minutes and this limits learning towards researching and questioning. In the study, science learning environment is considered as an important quality standard, on the other hand classroom size, number of



students, lack of materials and resources are identified as major problems. In Massachusetts 3-4 years-old early childhood program quality standard (2003), as much as learning environment, children-children and teacher-child interaction, program and assessment, family involvement, personnel quality and development, group size, health and safety, nutrition and food service, transportation services, management, accreditation and assessment are important, and these factors are discussed as a whole.

As highlighted earlier, preschool teachers have problems in selection and application of science concepts and topics during activities with children. Teachers feel incompetent about which science concepts they select according to children's cognitive structures, which methods to bring in these concepts, in other words, they feel incompetent about being effective using which methods and techniques they use and how to use these methods-techniques, how to prepare appropriate materials, also they have limited content knowledge in science and science training (Appleton, 1992; Çınar, 2013; Greenfield et al., 2009; Kallery and Psillos, 2001; Nayfeld, 2008, Tobin, Briscoe and Holman, 1990 cited Saçkes, 2015). As can be understood from research results, preschool teachers require solution suggestions and guidance about what should be included in science content to efficiently and affluently practice science activities and how to present this content affluently and how to evaluate such application. In this context, it is necessary to determine science content standards developmentally appropriate for preschool children and to implement these standards. Although children's level of having science content knowledge is closely related with their state of benefiting from preschool institution and teacher qualifications, in this regard, it is considered that factors belonging to parents such as level of education and profession play an important role.

In field literature review, it has been observed that there are not any studies in Turkey conducted towards determining the relationship between preschool children's level of having science content knowledge and various variables; and there are studies available towards usage of scientific research process skills both by preschool teachers and children (Büyüктаşkapu, 2010; Kefi, Çeliköz and Erişen, 2013; Pepele Ünal, 2006; Şahin, Güven and Yurdatapan, 2011). Outside Turkey, it has been determined that there have been many state and national science content standards determined from past to present, there are studies conducted that examine whether these standards are applied by teachers, however, there is only one study directly towards determining children's level of having these content standards and comparing this level with some variables (Guo et al., 2015). For this reason, this study is considered necessary. Since there are not any studies found directly related to this work in field literature review, results of studies considered to be indirectly related are given place in assessments conducted towards findings.

## **Method**

### ***Participants and Procedure***

The present study is a descriptive research in the scanning model. Research population consists of five to six-year-old children attending public kindergarten and preschool classes affiliated to the Ministry of Education in Burdur city center as of 2014-2015 academic year and their parents and teachers. In this study, 36 preschool teachers from 20 schools selected from different regions of Burdur city

center and a total of 360 children including 180 five-year-old and 180 six-year-old children, 182 of whom are females and 178 of whom are males are included as selected randomly from teachers' groups.

### ***Instrument and data collection***

As a data collection tool in the study, Science Content Standards Scale (SCSS) Trial Form developed by Taştepe (2012) based on science content subjects, field literature in and outside Turkey and at the same time international science content standards by considering scientific process skills was used. SCSS consists of a total 31 items and three subscales including 12-item Life Science, 9-item Physical Sciences, 10-item Earth and Space Sciences processing areas. 5-point likert scale is scored as "always" (5), "most of the time" (4), "sometimes" (3), "rarely" (2), "never" (1). It is the lowest score 31 and the highest score 155 will be obtained from scale. Total variance explaining factors is .65. Life Sciences explain .25 of total variance, Physical Sciences explain .21 of total variance and Earth/Space Sciences explain .19 of total variance. Item factor load values of the scale vary between .60-.84 in life sciences dimension; .58-.86 in Physical Sciences sub-dimension; .57-.71 in Earth and Space Sciences sub-dimension. In the field literature, 0.40-0.45 and higher item factor loads are considered as a good indicator (Kaiser, 1960, cited by DeVellis, 2003). Cronbach's Alpha reliability coefficient of the scale is .95 for Life Sciences sub-dimension; .94 for Physical Sciences sub-dimensions; .94 for Earth and Space Science sub-dimension. Reliability coefficient is the coefficients calculated as a result of applying scale/achievement tests on the target audience with language and scope validity provided. This coefficient is used with a view to analyze internal consistency between test scores. .70 and higher reliability values are considered to be a sufficient level of reliability (Büyüköztürk, 2010, p.170-171). İki ve ikiden fazla düzeyli karşılaştırmalarda kategorik değil sürekli ölçek toplam ve alt boyut puanları kullanılmıştır. SCSS-Trial Form was filled at the end of May 2015 by group teachers giving children training throughout the whole academic year.

### ***Research questions***

Do children's science content knowledge vary according to their age, gender, number of siblings, order of birth and duration of benefiting from preschool education?

Do children's science content knowledge vary according to age, educational status, occupational groups of parents?

### ***Analysis***

Since data collected with the measurement tool show normal distribution, score differences between groups were controlled using One-Way Analysis of Variance (ANOVA) technique, significance level was taken as 0.05, Scheffe analysis technique was used if variances in comparisons made in dimensions with statistically significant difference, and Tamhane analysis was used if variances are not equal.

## Results

Personal information about the children in the study group in Table 1, personal information about parents is presented in Table 2.

**Table 1.** Distribution of children as per age, gender, birth order, number of siblings, duration of preschool education

Variables	Age	N	%
<b>Age</b>	five year old	180	50.0
	six year old	180	50.0
	<b>total</b>	<b>360</b>	<b>100.0</b>
<b>Gender</b>	female	182	50.6
	male	178	49.4
	<b>total</b>	<b>360</b>	<b>100.0</b>
<b>Birth Rate</b>	first-born	182	50.6
	middle/one of middle	144	40.0
	last child	34	9.4
	<b>total</b>	<b>360</b>	<b>100.0</b>
<b>Number of Sibling</b>	an only child	101	28.1
	one sibling	201	55.8
	two sibling and over	58	16.1
	<b>total</b>	<b>360</b>	<b>100.0</b>
<b>Duration of Pre-school Education</b>	one year	266	73.9
	two year	65	18.1
	three year	29	8.1
	<b>total</b>	<b>360</b>	<b>100.0</b>

As it can be seen in Table 1, 50.0% of children are five years old, 50.0% of them are six years old; 50.6% of them are girls and 49.4% of them are boys. According to birth order, 50.6% of them are firstborn, 40.0% of them are middle child or one of middle children, 9.4% of them are last kid. Considering number of siblings among children, it can be seen that 28.1% of them are single child, 55.8% of them have a sibling, 16.1% of them have two or more siblings. It has been found that 73.9% of children attended preschool education for one year, 18.1% of them for two years and 8.1% of them for three years. It can be said that majority of children have benefited from preschool education one year.

As it can be seen in Table 2, while 36.4% of mothers are 30 years old or younger, 37.5% of them are 31-35 years old, 26.1% of them are 36-40 years old; 14.2% of fathers are 30 years old or younger, 39.4% of them are 31-35 years old, 30.0% of them are 36-40 years old and 16.4% of them are 41 years old and older. While there are no mothers older than 40 years old, 16.4% of fathers are older than 40 years old. While 16.9% of mothers are primary school graduates, 14.7% of them are middle school graduates, 31.4% of them are high school graduates, 34.2% of them have bachelor's degree and postgraduate degree in education; 14.2% of fathers are primary school graduates, 16.4% of them are secondary school graduates, 31.4% of them are high school graduates and 38.1% of them have bachelor's degree and postgraduate education level. Considering the vocational group, 30.6% of mothers are employees at public organization, 8.6% of them are workers at public organization, 9.2% of them are self-employed and 51.7% of them are housewives. Of fathers on the other hand, 30.6% of them are employees at public organization, 29.4% of them are workers at public organization, and 40.0% of them are self-employed.

**Table 2.** Distribution of parents as per age group, educational status and occupational groups

Variables		N	%
<b>Maternal Age</b>	30 and below	131	36,4
	31-35	135	37,5
	36-40	94	26,1
	Total	360	100,0
<b>Father's Age</b>	30 and below	51	14,2
	31-35	142	39,4
	36-40	108	30,0
	41 and over	59	16,4
	Total	360	100,0
<b>Mather's Educational Status</b>	Primary school graduated	61	16,9
	Secondary school graduated	53	14,7
	High school graduated	123	34,2
	Bachelor's degree and postgraduate	123	34,2
	Total	360	100,0
<b>Father's Educational Status</b>	Primary school graduated	51	14,2
	Secondary school graduated	59	16,4
	High school graduated	113	31,4
	Bachelor's degree and postgraduate	137	38,1
	Total	360	100,0
<b>Maternal Occupational Group</b>	Employees at public organization	110	30,6
	Workers at public organization	31	8,6
	Self-employed persons	33	9,2
	Other (housewife)	186	51,7
	Total	360	100,0
<b>Father's Occupational Group</b>	Employees at public organization	110	30,6
	Workers at public organization	106	29,4
	Self-employed persons	144	40,0
	Total	360	100,0

Results related to the first question of the survey are presented between table 3 and 10. Independent-Samples t Test results and arithmetical mean, standard deviation values regarding children's scores obtained from Science Content Standards Scale total and sub-dimensions as per age are presented in Table 3.

**Table 3.** Independent-Samples t-test and descriptive statistics results regarding Science Content Standards Scale total and sub-dimension scores according to age

SCSS Sub-dimensions	Age	n	$\bar{x}$	Sd	df	F	t	p
Physical Sciences	five year old	180	25,766	8,508	358	,018	-4,155	,000
	six year old	180	29,527	8,665				
	Total	360	27,647	8,779				
Life Sciences	five year old	180	45,488	10,038	358	,565	-3,802	,000
	six year old	180	49,388	9,412				
	Total	360	47,438	9,911				
Earth and Space Sciences	five year old	180	35,994	9,609	358	14,804	-4,374	,000
	six year old	180	40,005	7,684				
	Total	360	38,000	8,917				
SCSS Total	five year old	180	112,066	65,073	358	3,494	-4,568	,000
	six year old	180	123,955	80,515				
	Total	360	118,011	73,342				

$p < 0.05$

Analysis of Table 3 reveals that statistically significant differences are observed among children's scores from Science Content Standards Scale total ( $F=3,494$ ; five years old  $\bar{x} = 112,066$ , six years old  $\bar{x} = 123,955$ ;  $p < 0.05$ ), physical sciences ( $F=,018$ ,  $t = -4,155$ ; five years old  $\bar{x} = 25,766$ , six years old  $\bar{x} = 29,527$ ;  $p < 0.05$ ), life sciences ( $F=,565$ ,  $t = -3,802$ ; five years old  $\bar{x} = 45,488$ , six years old  $\bar{x} =$

49,388;  $p < 0.05$ ) and earth-space sciences ( $F = 14,804$ ,  $t = -4,374$ ; five years old  $\bar{x} = 35,994$ , six years old  $\bar{x} = 40,005$ ;  $p < 0.05$ ), sub-dimensions according to age.

Independent-Samples t-test and descriptive statistics results regarding children's scores obtained from Science Content Standards Scale total and sub-dimensions according to gender are presented in Table 4.

**Table 4.** Independent-Samples t Test and descriptive statistics results related to Science Content Standards Scale sub dimensions and total score according to children's gender

SCSS Sub-dimension	Gender	n	$\bar{x}$	Sd	df	F	t	p
Physical Sciences	Female	182	27,714	8,867	358	,009	,146	,926
	Male	178	27,578	8,713				
Life Sciences	Female	182	48,351	9,350	358	2,520	1,772	,113
	Male	178	46,505	10,397				
Earth and Space Sciences	Female	182	38,862	8,459	358	3,109	1,862	,079
	Male	178	37,118	9,302				
SCSS total	Female	182	115,131	23,596	358	,542	1,516	,462
	Male	178	111,247	25,002				

$p > 0.05$

Analyzing Table 4, there are not any statistically significant differences among children's scores from science content standards total ( $F = ,542$ ,  $t = 1,516$ ,  $p > 0.05$ ), physical sciences ( $F = ,009$ ,  $t = ,146$ ,  $p > 0.05$ ), life sciences ( $F = 2,520$ ,  $t = 1,772$ ,  $p > 0.05$ ) and earth-space sciences ( $F = 3,109$ ,  $t = 1,862$ ,  $p > 0.05$ ) sub-dimension according to gender.

One-Way Analysis of Variance (ANOVA) results regarding children's scores obtained from Science Content Standards Scale total and sub-dimensions according to birth order are presented in Table 5.

**Table 5.** One-Way Analysis of Variance (ANOVA) results regarding science content standards scale total and sub-dimension scores as per children's birth order

SCSS Sub-Dimension	The source of variance	Sum of Squares	df	Mean Square	F	p
Physical Sciences	Between Groups	724,047	2	362,024	4,796	,009*
	Within Groups	26948,150	357	75,485		
	Total	27672,197	359			
Life Science	Between Groups	514,791	2	257,396	2,644	,072
	Within Groups	34749,864	357	97,339		
	Total	35264,656	359			
Earth and Space Sciences	Between Groups	812,882	2	406,441	5,232	,006*
	Within Groups	27733,118	357	77,684		
	Total	28546,000	359			
SCSS Total	Between Groups	3657,302	2	1828,651	,339	,713
	Within Groups	1927458,654	357	5399,044		
	Total	1931115,956	359			

\* $p < 0.05$

As can be seen in Table 5, while there is a statistically significant difference between children's scores in science content standards scale physical sciences ( $F = 4,796$ ,  $p < 0.05$ ), earth and space sciences ( $F = 5,232$ ,  $p < 0.05$ ) sub-dimensions, there are not any significant differences in their life sciences ( $F = 2,644$ ,  $p > 0.05$ ) sub-dimension and scale total scores ( $F = ,339$ ,  $p > 0.05$ ).

Multiple comparisons Scheffe results regarding physical sciences, earth and space sciences sub-dimensions of science content standards scale as per children's birth order are presented in Table 6.

**Table 6.** Scheffe results regarding children's scores from Science Content Standards Scale physical sciences and earth-space sciences sub-dimensions as per their birth order

SCSS Sub-dimension	(I)1	(J)2	$\bar{x}_{1-2}$ (I-J)	S <sub>x</sub>	p
Physical Sciences	first-born	middle /one of middle last child	1.32341 4.93697*	.96900 1.62324	394 .010*
	middle /one of middle	first-born last child	1.32341 3.61356	.96900 1.65661	394 .094
	last Child	first-born middle /one of middle	4.93697(*) -3.61356	1.62324 1.65661	.010 .094
	first-born	middle /one of middle last child	1.84074 5.00291*	.98301 1.64671	.175 .010*
Earth and Space Sciences	middle /one of middle	first-born last child	-1.84074 3.16217	.98301 1.68056	.175 .172
	last child	first child middle /one of middle	-5.00291* -3.16217	1.64671 1.68056	.010 .172

\* $p < 0.05$ 

Analysis of Table 6 reveals that statistically significant difference is observed between the first-born and last child in favor of firstborn regarding children's scores from physical sciences sub-dimensions as per birth order ( $\bar{x}_{1-2} = 4.9369$ ,  $p < 0.05$ ), again in favor of first-born in earth and space sciences sub-dimension scores ( $\bar{x}_{1-2} = 5.00291$ ,  $p < 0.05$ ).

One-Way Analysis of Variance (ANOVA) results regarding children's scores obtained from Science Content Standards Scale total and sub-dimensions as per number of siblings are presented in Table 7.

**Table 7.** One-Way Analysis of Variance (ANOVA) results regarding Science Content Standards Scale total and sub-dimension scores as per number of siblings

SCSS Sub-dimension	The source of variance	Sum of Squares	df	Mean Square	F	p
Physical Sciences	Between Groups	814,750	2	407,375	5,415	,005*
	Within Groups	26857,448	357	75,231		
	Total	27672,197	359			
Life Sciences	Between Groups	752,930	2	376,465	3,894	,021*
	Within Groups	34511,726	357	96,672		
	Total	35264,656	359			
Earth and Space Sciences	Between Groups	638,464	2	319,232	4,084	,018*
	Within Groups	27907,536	357	78,172		
	Total	28546,000	359			
SCSS Total	Between Groups	1346,281	2	673,141	,125	,883
	Within Groups	1929769,674	357	5405,517		
	Total	1931115,956	359			

\* $p < 0.05$ 

As it can be seen in Table 7, while statistically significant difference is determined between children's scores in SCSS, physical sciences ( $F = 5.415$ ,  $p < 0.05$ ), life sciences ( $F = 3.894$ ,  $p < 0.05$ ), earth and space sciences ( $F = 4.084$ ,



$p < 0.05$ ) sub-dimensions, there are not any significant differences in scale total scores as per number of siblings ( $F = .125$ ,  $p > 0.05$ ).

Multiple comparisons Tamhane results regarding Science Content Standards Scale physical sciences sub-dimension scores, multiple comparisons Scheffe results regarding life sciences and space sciences sub-dimension scores as per children's number of siblings are presented in Table 8.

**Table 8.** Children's multiple comparisons Tamhane results related to Science Content Standards Scale physical sciences sub-dimension scores, Scheffe results related to life sciences and space sciences sub-dimension scores as per number of siblings

SCSS Sub-dimension	(I)	(J)	$\bar{x}_{1-2}$ (I-J)	$S_x$	p
Physical Sciences	an only child	one sibling	2,70218(*)	1,01614	,025*
		two sibling and over	4,37863(*)	1,37091	,005*
	one sibling	an only child	-2,70218(*)	1,01614	,025
		two sibling and over	1,67645	1,28950	,482
Life Sciences	two sibling and over	an only child	-4,37863(*)	1,37091	,005
		one sibling	-1,67645	1,28950	,482
	an only child	one sibling	2,73322	1,19921	,076
		two sibling or more	4,08928(*)	1,61984	,042*
Earth and Space Sciences	one sibling	an only child	-2,73322(*)	1,19921	,076
		two sibling or more	1,35606	1,46550	,652
	two sibling and over	an only child	-4,08928(*)	1,61984	,042
		one sibling	-1,35606	1,46550	,652
Earth and Space Sciences	an only child	one sibling	2,15497	1,07838	,137
		two sibling and over	4,02390(*)	1,45663	,023*
	one sibling	an only child	-2,15497	1,07838	,137
		two sibling and over	1,86893	1,31785	,367
	two sibling and over	an only child	-4,02390(*)	1,45663	,023
	one sibling	-1,86893	1,31785	,367	

\* $p < 0.05$

Analysis of Table 8 reveals that statistically significant difference is observed children's physical sciences sub-dimension scores in favor of an only as per number of siblings between children who are the only child and who have one sibling ( $\bar{x}_{1-2} = 2,70218$ ,  $p < 0.05$ ), between children who are the only child and who have two or more siblings ( $\bar{x}_{1-2} = 4,37863$ ,  $p < 0.05$ ), in life sciences sub-dimension scores, between children who are the only child and who have two or more siblings ( $\bar{x}_{1-2} = 4,08928$ ,  $p < 0.05$ ), in earth and space sciences sub-dimension scores, between children who are the only child and who have two or more siblings ( $\bar{x}_{1-2} = 4,02390$ ,  $p < 0.05$ )

One-Way Analysis of Variance (ANOVA) results regarding children's Science Content Standards Scale total and sub-dimensions scores as per duration of preschool education are presented in Table 9.

Analysis of Table 9 reveals that statistically significant differences are observed among children's scores from Science Content Standards Scale total ( $F = 3.861$ ;  $p < 0.05$ ), physical sciences ( $F = 10.304$ ;  $p < 0.05$ ), life sciences ( $F = 19.275$ ;  $p < 0.05$ ) and earth-space sciences ( $F = 12.582$ ;  $p < 0.05$ ) sub-dimensions as per duration of preschool education.

**Table 9.** One-Way Analysis of Variance (ANOVA) Results Regarding Science Content Standards Scale Total and Sub-Dimension Scores as per Children's Duration of Preschool Education

SCSS Sub-dimension	The source of variance	Sum of Squares	df	Mean Square	F	p
Physical Sciences	Between Groups	1510,155	2	755,077	10,304	,000
	Within Groups	26162,043	357	73,283		
	Total	27672,197	359			
Life Sciences	Between Groups	3436,883	2	1718,441	19,275	,000
	Within Groups	31827,773	357	89,153		
	Total	35264,656	359			
Earth and Space Sciences	Between Groups	1879,705	2	939,852	12,582	,000
	Within Groups	26666,295	357	74,696		
	Total	28546,000	359			
SCSS Total	Between Groups	40888,473	2	20444,237	3,861	,022
	Within Groups	1890227,482	357	5294,755		
	Total	1931115,956	359			

$p < 0.05$

Multiple comparisons Tamhane results regarding Science Content Standards Scale physical sciences sub-dimension scores, multiple comparisons Scheffe results regarding life sciences and space sciences sub-dimension scores as per children's duration of preschool education are presented in Table 10.

**Table 10.** Tamhane results regarding Science Content Standards Scale physical sciences sub-dimension score and Scheffe results regarding life sciences, earth and space sciences sub-dimension scores and total score as per children's duration of preschool education

SCSS Sub-dimension	(I)	(J)	$\bar{x}_{1-2}$ (I-J)	$S_x$	p
Physical Sciences	One year	Two year	-4,82921(*)	1,212	,000
		Three year	-4,25732(*)	1,248	,004
	Two year	One year	4,82921(*)	1,212	,000*
		Three year	,57188	1,566	,977
	Three year	One year	4,25732(*)	1,248	,004*
		Two year	-,57188	1,566	,977
Life Sciences	One year	Two year	-7,47293(*)	1,306	,000
		Three year	2,94776	1,846	,281
	Two year	One year	7,47293(*)	1,306	,000*
		Three year	10,42069(*)	2,108	,000*
	Three year	One year	-2,94776	1,846	,281
		Two year	-10,42069(*)	2,108	,000
Earth and Space Sciences	One year	Two year	-5,99277(*)	1,195	,000
		Three year	-,80179	1,690	,894
	Two year	One year	5,99277(*)	1,195	,000*
		Three year	5,19098(*)	1,929	,028*
	Three year	One year	,80179	1,690	,894
		Two year	-5,19098(*)	1,929	,028
SCSS Total	One year	Two year	-27,50434(*)	10,067	,025
		Three year	1,77418	14,229	,992
	Two year	One year	27,50434(*)	10,067	,025*
		Three year	29,27851	16,249	,199
	Three year	One year	-1,77418	14,229	,992
		Two year	-29,27851	16,249	,199

\* $p < 0.05$

As can be seen in Table 10, as per children's duration of preschool education, there is statistically significant difference in Science Content Standards Scale total score between children with preschool education for one year and children with two years in favor of children with two years of preschool education ( $\bar{x}_{1-2}=27.50434$ ,  $p<0.05$ ), in physical sciences sub-dimension scores, between children with preschool education for one year and children with two years in favor of children with two years of preschool education ( $\bar{x}_{1-2}=4.82921$ ,  $p<0.05$ ), between children with preschool education for one year and children with three years in favor of children with three years of preschool education ( $\bar{x}_{1-2}=4.25732$ ,  $p<0.05$ ), in life sciences sub-dimension scores, between children with preschool education for one year and children with two years in favor of children with two years of preschool education ( $\bar{x}_{1-2}=7.47293$ ,  $p<0.05$ ), between children with preschool education for three years and children with two years in favor of children with two years of preschool ( $\bar{x}_{1-2}=10.42069$ ,  $p<0.05$ ), in earth and space sciences sub-dimension scores, between children with preschool education for one year and children with two years in favor of children with two years of preschool education ( $\bar{x}_{1-2}=5.99277$ ,  $p<0.05$ ) and between children with preschool education for two years and children with three years in favor of children with two years of preschool education ( $\bar{x}_{1-2}=5.19098$ ,  $p<0.05$ ).

Results related to the second question of the survey are presented between table 11 and 19.

One-Way Analysis of Variance (ANOVA) results regarding children's scores obtained from Science Content Standards Scale total and sub-dimensions as per mothers' age group are presented in Table 11.

**Table 11.** One-Way Analysis of Variance (ANOVA) results of children's Science Content Standards Scale total and sub-dimensions scores as per mothers' age group

SCSS Sub-dimension	The source of Variance	Sum of Squares	df	Mean Square	F	p
Physical Sciences	Between Groups	48,321	2	24,161	,312	,732
	Within Groups	27623,876	357	77,378		
	Total	27672,197	359			
Life Sciences	Between Groups	232,328	2	116,164	1,184	,307
	Within Groups	35032,327	357	98,130		
	Total	35264,656	359			
Earth and Space Sciences	Between Groups	57,361	2	28,680	,359	,698
	Within Groups	28488,639	357	79,800		
	Total	28546,000	359			
SCSS Total	Between Groups	5831,549	2	2915,775	,541	,583
	Within Groups	1925284,406	357	5392,954		
	Total	1931115,956	359			

$p>0.05$

As it can be seen in Table 11, children's scores obtained from Science Content Standards total ( $F=.541$ ;  $p>0.05$ ), physical sciences ( $F=.312$ ;  $p>0.05$ ), life sciences ( $F=1.184$ ;  $p>0.05$ ) and earth-space sciences ( $F=.359$ ;  $p>0.05$ ) sub-dimension do not vary as per mothers' age group.

One-Way Analysis of Variance (ANOVA) results related to children's scores obtained from Science Content Standards Scale total and sub-dimensions as per fathers' age group are presented in Table 12.

**Table 12.** One-Way Analysis of Variance (ANOVA) results of children's Science Content Standards Scale total and sub-dimension scores as per fathers' age group

SCSS Sub-dimension	The source of variance	Sum of Square	df	Mean Square	F	p
Physical Sciences	Between Groups	203,231	3	67,744	,878	,453
	Within Groups	27468,966	356	77,160		
	Total	27672,197	359			
Life Sciences	Between Groups	451,885	3	150,628	1,540	,204
	Within Groups	34812,771	356	97,789		
	Total	35264,656	359			
Earth and Space Sciences	Between Groups	151,995	3	50,665	,635	,593
	Within Groups	28394,005	356	79,758		
	Total	28546,000	359			
SCSS Total	Between Groups	9796,413	3	3265,471	,605	,612
	Within Groups	1921319,542	356	5396,965		
	Total	1931115,956	359			

$p > 0.05$

Analysis of Table 12 reveals that any statistically significant differences are not determined among children's scores obtained from Science Content Standards scale total ( $F=.605$ ;  $p > 0.05$ ), physical sciences ( $F=.878$ ;  $p > 0.05$ ), life sciences ( $F=1.540$ ;  $p > 0.05$ ) and earth-space sciences ( $F=.635$ ;  $p > 0.05$ ) sub-dimension as per fathers' age group.

One-Way Analysis of Variance (ANOVA) results regarding children's scores obtained from Science Content Standards Scale total and sub-dimensions as per mothers' status of education are given in Table 13, and multiple comparisons Scheffe results are presented in Table 14.

**Table 13.** One-Way Analysis of Variance (ANOVA) Results of children's Science Content Standards Scale total and sub-dimension scores as per mothers' status of education

SCSS Sub-dimension	The source of variance	Sum of Square	df	Mean Square	F	p
Physical Sciences	Between Groups	1373,297	3	457,766	6,197	,000*
	Within Groups	26298,900	356	73,873		
	Total	27672,197	359			
Life Sciences	Between Groups	951,168	3	317,056	3,289	,021*
	Within Groups	34313,487	356	96,386		
	Total	35264,656	359			
Earth and Space Sciences	Between Groups	472,360	3	157,453	1,997	,114
	Within Groups	28073,640	356	78,859		
	Total	28546,000	359			
SCSS Total	Between Groups	7437,703	3	2479,234	,459	,711
	Within Groups	1923678,253	356	5403,591		
	Total	1931115,956	359			

\* $p < 0.05$

As it can be seen in Table 13, while there is a statistically significant difference between children's scores in Science Content Standards scale, physical

sciences ( $F=6.197$ ,  $p<0.05$ ), life sciences ( $F=3.289$ ,  $p<0.05$ ) sub-dimensions as per mothers' status of education, there are not any significant differences determined in their earth and space sciences ( $F=1.997$ ,  $p>0.05$ ) and scale total scores ( $F=.459$ ,  $p>0.05$ ).

**Table 14.** Scheffe results of children's scores obtained from Science Content Standards Scale total and sub-dimensions as per mothers' educational status

SCSS	(I)	(J)	$\bar{x}_{1-2}$ (I-J)	$S_x$	p
<b>Sub-dimension</b>					
<b>Physical Sciences</b>	Primary School Graduated	Secondary School Graduated	-,80019	1,614	,970
		High School Graduated	-4,60629(*)	1,345	,009
		Bachelor's Degree or Higher Degree	-4,47621(*)	1,346	,012
	Secondary School Graduated	Primary School Graduated	,80019	1,614	,970
		High School Graduated	-3,80611	1,412	,066
		Bachelor's Degree or Higher Degree	-3,67602	1,412	,081
	<b>High School Graduated</b>	<b>Primary School Graduated</b>	<b>4,60629(*)</b>	<b>1,346</b>	<b>,009*</b>
		Secondary School Graduated	3,80611	1,412	,066
		Bachelor's Degree or Higher Degree	,13008	1,09599	1,000
	<b>Bachelor's Degree or Higher Degree</b>	<b>Primary School Graduated</b>	<b>4,47621(*)</b>	<b>1,34597</b>	<b>,012*</b>
		Secondary School Graduated	3,67602	1,41224	,081
		High School Graduated	-,13008	1,09599	1,000
<b>Life Sciences</b>	Primary School Graduated	Secondary School Graduated	-4,01547	1,84356	,194
		High School Graduated	-4,43209(*)	1,53744	,042
		Bachelor's Degree or Higher Degree	-4,33453(*)	1,53744	,049
	Secondary School Graduated	Primary School Graduated	4,01547	1,84356	,194
		High School Graduated	-,41663	1,61314	,996
		Bachelor's Degree or Higher Degree	-,31907	1,61314	,998
	<b>High School Graduated</b>	<b>Primary School Graduated</b>	<b>4,43209(*)</b>	<b>1,53744</b>	<b>,042*</b>
		Secondary School Graduated	,41663	1,61314	,996
		Bachelor's Degree or Higher Degree	,09756	1,25190	1,000
	<b>Bachelor's Degree or Higher Degree</b>	<b>Primary School Graduated</b>	<b>4,33453(*)</b>	<b>1,53744</b>	<b>,049*</b>
		Secondary School Graduated	,31907	1,61314	,998
		High School Graduated	-,09756	1,25190	1,000

\* $p<0.05$

As it can be seen in Table 14, statistically significant difference is determined among children's Science Content Standards Scale physical sciences sub-dimension scores as per mothers' educational level in favor of high school graduate mothers between high school graduate mothers and primary school graduate mothers ( $\bar{x}_{1-2}=4.60629$ ,  $p<0.05$ ), in favor of mothers with bachelor's degree and postgraduate degree in education between primary school graduate mothers and mothers with bachelor's degree and postgraduate degree in education ( $\bar{x}_{1-2}=4.47621$ ,  $p<0.05$ ); in life sciences sub-dimension scores in favor of high school graduate mothers between high school graduate mothers and primary school graduate mothers ( $\bar{x}_{1-2}=4.43209$ ,  $p<0.05$ ), in favor of mothers with bachelor's

degree and postgraduate degree in education between primary school graduate mothers and mothers with bachelor's degree and postgraduate degree in education ( $\bar{x}_{1.2}=4.33453$ ,  $p<0.05$ ).

One-Way Analysis of Variance (ANOVA) results regarding children's scores obtained from Science Content Standards Scale total and sub-dimensions as per fathers' status of education are given in Table 15, multiple comparisons Scheffe results are presented in Table 16.

**Table 15.** One-Way Analysis of Variance (ANOVA) results of children's Science Content Standards Scale total and sub-dimensions scores as per fathers' status of education

SCSS Sub-dimension	The source of variance	Sum of Square	df	Mean Square	F	p
Physical Sciences	Between Groups	1418,461	3	472,820	6,411	,000*
	Within Groups	26253,737	356	73,746		
	Total	27672,197	359			
Life Sciences	Between Groups	1270,531	3	423,510	4,435	,004*
	Within Groups	33994,125	356	95,489		
	Total	35264,656	359			
Earth and Space Sciences	Between Groups	537,189	3	179,063	2,276	,080
	Within Groups	28008,811	356	78,676		
	Total	28546,000	359			
SCSS Total	Between Groups	7544,069	3	2514,690	,465	,707
	Within Groups	1923571,886	356	5403,292		
	Total	1931115,956	359			

\* $p<0.05$

As it can be seen in Table 15, while there is a statistically significant difference between children's scores in Science Content Standards scale, physical sciences ( $F=6.411$ ,  $p<0.05$ ), life sciences ( $F=4.435$ ,  $p<0.05$ ) sub-dimensions as per fathers' status of education, there are not any significant differences determined in their earth and space sciences ( $F=2.276$ ,  $p>0.05$ ) and scale total scores ( $F=.465$ ,  $p>0.05$ ).

As can be seen in Table 16, statistically significant difference is determined among children's Science Content Standards Scale physical sciences sub-dimension scores as per fathers' educational level in favor of high school graduate fathers between high school graduate fathers and primary school graduate fathers ( $\bar{x}_{1.2}=5.21898$ ,  $p<0.05$ ), in favor of fathers with bachelor's degree and postgraduate degree in education between primary school graduate fathers and fathers with bachelor's degree and postgraduate degree in education ( $\bar{x}_{1.2}=5.40947$ ,  $p<0.05$ ); in life sciences sub-dimension scores in favor of high school graduate fathers between high school graduate fathers and primary school graduate fathers ( $\bar{x}_{1.2}=5.73521$ ,  $p<0.05$ ), in favor of fathers with bachelor's degree and postgraduate degree in education between primary school graduate fathers and fathers with bachelor's degree and postgraduate degree in education ( $\bar{x}_{1.2}=5.18563$ ,  $p<0.05$ ).



**Table 16.** Scheffe results of children's scores obtained from Science Content Standards Scale total and sub-dimensions as per fathers' educational status

SCSS-Sub-dimension	(I)	(J)	$\bar{x}_{1-2}$ (I-J)	S <sub>x</sub>	p		
Physical Sciences	Primary Graduated	School	Secondary School	-2,32968	1,64193	,570	
		High School		-5,21898(*)	1,44867	,005	
		Bachelor's Degree or Higher Degree		-5,40947(*)	1,40865	,002	
	Secondary School	Graduate	Primary School		2,32968	1,64193	,570
			High School		-2,88931	1,37933	,224
			Bachelor's Degree or Higher Degree		-3,07980	1,33725	,153
	High School	Graduate	Primary School		5,21898*	1,44867	,005*
			Secondary School		2,88931	1,37933	,224
			Bachelor's Degree or Higher Degree		-,19049	1,09129	,999
	Bachelor's Degree or Higher Degree	Graduate	Primary School		5,40947*	1,40865	,002*
			Secondary School		3,07980	1,33725	,153
			High School		-,19049	1,09129	,999
	Life Sciences	Primary Graduated	School	Secondary School	-4,65736	1,86837	,104
			High School		-5,73521(*)	1,64845	,008
Bachelor's Degree or Higher Degree				-5,18563(*)	1,60291	,016	
Secondary School		Graduate	Primary School		4,65736	1,86837	,104
			High School		-1,07785	1,56955	,925
			Bachelor's Degree or Higher Degree		-,52827	1,52166	,989
High School		Graduate	Primary School		5,73521*	1,64845	,008*
			Secondary School		1,07785	1,56955	,925
			Bachelor's Degree or Higher Degree		,54958	1,24179	,978
Bachelor's Degree or Higher Degree		Graduate	Primary School		5,18563*	1,60291	,016*
			Secondary School		,52827	1,52166	,989
			High School		-,54958	1,24179	,978

\* $p < 0.05$

One-Way Analysis of Variance (ANOVA) results regarding children's scores obtained from Science Content Standards Scale total and sub-dimensions as per mothers' occupational group are given in Table 17, and multiple comparisons Scheffe results are presented in Table 18.

As can be seen in Table 17, while there is a statistically significant difference between children's scores in Science Content Standards scale, physical sciences ( $F=3.256$ ,  $p < 0.05$ ) sub-dimensions as per mothers' occupational group, there are not any significant differences determined in their life sciences ( $F=1.907$ ,  $p < 0.05$ ), earth and space sciences ( $F=1.496$ ,  $p > 0.05$ ) and scale total scores ( $F=.375$ ,  $p > 0.05$ ).

**Table 17.** One-Way Analysis of Variance (ANOVA) results of children's Science Content Standards Scale total and sub-dimension scores as per mothers' occupational Group

SCSS Sub-dimension	The source of variance	Sum of Square	df	Mean Square	F	p
Physical Sciences	Between Groups	739,045	3	246,348	3,256	,022*
	Within Groups	26933,153	356	75,655		
	Total	27672,197	359			
Life Sciences	Between Groups	557,790	3	185,930	1,907	,128
	Within Groups	34706,865	356	97,491		
	Total	35264,656	359			
Earth and Space Sciences	Between Groups	355,437	3	118,479	1,496	,215
	Within Groups	28190,563	356	79,187		
	Total	28546,000	359			
SCSS Total	Between Groups	6078,772	3	2026,257	,375	,771
	Within Groups	1925037,184	356	5407,408		
	Total	1931115,956	359			

\* $p < 0.05$ 

As can be seen in Table 18, statistically significant difference is determined in children's Science Content Standards Scale sub-dimension scores as per mothers' occupational group in favor of mothers working as employees at public organization between housewife mothers and employee mothers ( $\bar{x}_{1-2}=2.29795$ ,  $p < 0.05$ ), in favor of worker mothers between worker mothers at public organization and housewife mothers ( $\bar{x}_{1-2}=4.48387$ ,  $p < 0.05$ ).

**Table 18.** Scheffe results of children's scores obtained from Science Content Standards Scale total and sub-dimensions as per mothers' occupational group

SCSS-Sub-dimension	(I)	(J)	$\bar{x}_{1-2}$ (I-J)	$S_x$	p
Physical Sciences	Employees at Public Organization	Workers at Public Organization	-2,18592	1,76869	,217
		Self-Employed Persons	1,47879	1,72637	,392
		Other (housewife)	2,29795*	1,04619	,029*
	Workers at Public Organization	Employees at Public Organization	2,18592	1,76869	,217
		Self-Employed Persons	3,66471	2,17556	,093
		Other (housewife)	4,48387*	1,68737	,008*
	Self-Employed Persons	Employees at Public Organization	-1,47879	1,72637	,392
		Workers at Public Organization	-3,66471	2,17556	,093
		Other (housewife)	,81916	1,64296	,618
	Other (housewife)	Employees at Public Organization	-2,29795 (*)	1,04619	,029
		Workers at Public Organization	-4,48387 (*)	1,68737	,008
		Self-Employed Persons	-,81916	1,64296	,618

\* $p < 0.05$ 

One-Way Analysis of Variance (ANOVA) results regarding children's scores obtained from Science Content Standards Scale total and sub-dimensions as per fathers' occupational group are presented in Table 19.

**Table 19.** One-Way Analysis of Variance (ANOVA) results of children's Science Content Standards Scale total and sub-dimension scores as per fathers' occupational group

SCSS Sub-dimension	The source of variance	Sum of Squares	df	Mean Square	F	p
Physical Sciences	Between Groups	66,647	2	33,323	,431	,650
	Within Groups	27605,550	357	77,326		
	Total	27672,197	359			
Life Sciences	Between Groups	56,501	2	28,250	,286	,751
	Within Groups	35208,155	357	98,622		
	Total	35264,656	359			
Earth and Space Sciences	Between Groups	102,293	2	51,147	,642	,527
	Within Groups	28443,707	357	79,674		
	Total	28546,000	359			
SCSS Total	Between Groups	9077,823	2	4538,911	,843	,431
	Within Groups	1922038,133	357	5383,860		
	Total	1931115,956	359			

$p > 0.05$

As can be seen in Table 19, children's scores obtained from Science Content Standards total ( $F = .843$ ;  $p > 0.05$ ), physical sciences ( $F = .431$ ;  $p > 0.05$ ), life sciences ( $F = .286$ ;  $p > 0.05$ ) and earth-space sciences ( $F = .642$ ;  $p > 0.05$ ) sub-dimensions do not vary as per fathers' occupational group.

### Discussion and Conclusion

In this research conducted to determine five to six-year-old children's knowledge of science content, study group constitutes of 360 children attending preschool educational institutions in Burdur city center and their parents and teachers. In the study, Science Content Standards Scale (SCSS) Trial Form developed by Taştepe (2012) was used. Since data show normal distribution, group score differences were analyzed with one-way analysis of variance (ANOVA) technique. Difference among groups is tested using Scheffe technique if variances are equal, and using Tamhane techniques if variances are not equal.

As a result of the study, any statistically significant differences were not found among children's understanding of science content according to gender. This finding supports the finding by Guo *et al.* (by 2015) that the gap between children's knowledge of science content is not the result of gender. From this finding, it can be concluded that parents and teachers are in an effort to improve children's skills in areas of scientific processes and concepts related to science without distinction of gender. In addition, with rising educational status of women in the modern education system and increase in number of working women, effectiveness of mother in the family has also increased. Number of children in the family began to decrease, so education of child in the family has become more important, and girl-boy distinction has been removed (Dirim, 2003, p.35). In families where the child is perceived as an individual, child's gender does not affect parents' behaviors (Bilgin Aydın, 2003, p.46). According to Republic of Turkey State Planning Organization and World Bank Welfare and Social Policy Analytical Work Program report (2010, p.2), if girls are enrolled in schools, they do not fall behind boys in terms of success and they can be more successful.

Saçkes *et al.* (2013), different from this study, found out that gender is a significant predictor of science knowledge performance. Dubosarsky (2011) has also determined that there is difference in science concepts developed by children

according to gender. Despite not being directly related this study, in the study conducted by Kesicioğlu (2008), it has been determined that children's attitudes towards nature are statistically significant difference according to gender in favor of boy. Also in the study by Kesik (2016) related to third grade students' science literacy, difference among children's science knowledge was found according to gender.

On the other hand, in the longitudinal study conducted with 116 children of 4-6 and 6-8 year-old by Leibham, Alexander and Johnson (2013) with a view to reveal potential effects of children's science interests on their future development and learning, it has been found that early interest in science (4-6 year-old) is higher among boys more than girls, however, this early interest is more effective on girls' positive self-concept and science-related success scores compare to 8 year-old boys. Differences in scores may have arisen from different socio-cultural, socio-economic and educational conditions.

The finding in the study that six year-old children's science content knowledge in the present study were found higher than those of five year-old children can be said to originate not only from the development of children's perceptive and cognitive perspectives regarding science in parallel with the effect of development and environmental with the increasing age, but also two years of preschool education as determined in cross-comparisons of six year-old children (despite being outside the scope of research).

While difference among children's scores obtained from physical sciences, earth and space sciences is observed in favor of firstborn, no differences in life sciences and total score are not determined. While concepts about life sciences are easily acquired by children in natural environment and every conditions, concepts related to physical sciences, earth and space sciences may require special support, more specific states, life and sources and more educated and cultured parents. In study by Şahin (2012) in which the relationship between perception of fatherhood role and involvement in family studies by fathers with five or six-year-old child were examined, it is found out that fathers participated in education of their firstborn and their perception of fatherhood role is higher than the other groups.

In the present study, the fact that children's scores obtained from physical sciences, life sciences, earth and space sciences sub-dimensions according to number of siblings were in favor of only child in the family lead researches to think that families have an effort to raise firstborn children in a more perfectionist way, on the other hand, more perfectionist raising of first and only child can be said to originate from having more expectations from these children and having more rich opportunities and interest in terms of facilities and equipment. Similarly, Şahin (2012) in his study has revealed that fathers with single child have higher levels of perception of fatherhood and participation in children's education.

The fact that Science Content Standards Scale total score and sub-dimension scores are in favor of children with two years of preschool education reveals the importance of preschool education, it is observed that having three years of preschool education has only an effect on content knowledge in physical science. It is an expected finding as emphasized in the field literature and results of applied researches. That is because physical sciences are considered as difficult to teach and bring in on the side of teachers and teacher candidates (Aykut, 2006;

Brigido *et al.*, 2012; Brown *et al.*, 2014; Charlesworth *et al.*, 2003; Johnston and Ahtee, 2006; Kallery and Psillos, 2001; Tosun, 2000; Uysal, 2007; Wenner, 1993; Yılmaz Tüzün, 2008). Although teachers feel themselves as inadequate in this regard, it is thought that they are in effort to bring in concepts related to this field. Children's continued period of three years to preschool education contributes to their physical sciences field knowledge that are perceived as difficult.

Different from this study and despite not directly related to the research, in the study conducted by Koçak (2009), it has been determined that children's average scores obtained from early learning skills sub-scales that are also referred to as the scientific process skills and include learning skills do not vary significantly according to duration of preschool education.

In the present study, it has been determined that children's science content knowledge do not vary significantly according to parents' age. In the study conducted by Koçak (2009), it is revealed that early learning skill scores by children of mothers in 36-year-old and older group are higher compared to scores by children of mothers in 20-25 and 26-35 age group. Similarly, findings of the study conducted by Şahin (2012) show that level of participation by father increases as father's age increases. On the contrary, Aksu and Karaçöp (2015) have determined in their study conducted with parents who have children at secondary school level that 30-year-old and younger parents have higher level of participation to home-based science activities and self-development efforts regarding participation when compared to parents in other age groups.

Another finding of this research is related to parents' educational status. It has been identified that educational status of parents makes a difference in children's scores obtained from science standards, physical sciences and life sciences sub-dimensions. In both sub-dimension scores, statistically significant difference was found between high school and primary school graduate mothers in favor of high school graduate mothers, and between high school and primary school graduate fathers in favor of high school graduate fathers. Statistically significant difference was found between primary school graduate mothers and mothers with bachelor's degree or higher status of education in favor of mothers with bachelor's degree or higher status of education, and between primary school graduate fathers and fathers with bachelor's degree and higher status of education in favor of fathers with bachelor's degree or higher status of education. This finding of the study supports results from the study by Kesicioğlu (2008) revealing that natural environment experiences offered to children by families differ in favor of bachelor's degree graduate mothers and fathers. Besides, Şahin (2012) in his study determined that, as father's level of education increases, his perception of fatherhood role and participation to family activities related to his child also increase. Also in the study by Kesik (2016) related to third grade students' science literacy, difference among children's science knowledge was found according to parents' status of education.

As parents' status of education increases, there is an increase observed in children's scores obtained from science content standards, physical sciences and life sciences sub-dimensions excluding earth and space sciences sub-dimensions. Guo *et al.* (2015) in their study found statistically significant difference among children's science content knowledge in favor of mothers with bachelor's degree education as per mothers' level of education. According to Tansel (2002), parents'

level of education is one of important factors determining children's academic performance. Morrison (2009) has pointed out that children with more knowledge thanks to natural environment experiences offered by parents tend to protect and show respect to the world and its natural resources. Parents with high level of education are able to offer their children more experiences since they are aware of this fact and have probably better living conditions. According to Oral and McGivney (2014, p.8), the higher father's education level is, the higher educational expenditure becomes at primary education level. Bachelor's degree fathers spend three times more money on their children's education compared to high school graduate fathers; on the other hand, high school graduate fathers invest in children's education two times more than secondary school graduate fathers.

According to data from PISA (2012), it is emphasized that, in Turkey, there is difference of about 59 points in the field of mathematics between children of families with high level of education in which one of parents has continued their education after high school and children of families with lower level of education in which one of parents has an educational background less than eight years. In other words, there is a success difference that approximately corresponds to one and half academic years for students at the same grade level between children from families with higher education level and children from families with less than eight years of education (OECD, 2013). According to Republic of Turkey State Planning Organization and World Bank Welfare and Social Policy Analytical Work Program (2010) data, one of factors explaining the highest level of equal opportunity in education is parents' level of education. In a number of studies, it has been determined that families with higher level of education participate in their children's education more (Şahin, 2012), in addition to more participation in children's education, they encourage their children to solve problems and in parallel with this, they have higher levels of expectations with their children (Englund, Luckner, Whaley and Egeland, 2004; McNeal Jr., 2001; Salıcı-Ahioğlu, 2006; Zellman and Waterman, 1998).

In a study conducted with first grade students by Süren (2008) and in a study conducted by Baz (2003) with a view to determine 7th and 8th grade students' levels of scientific literacy in primary education, it was revealed that students from families with high level of education have higher levels of scientific literacy. Also in a study conducted by Aydınli (2007) with a view to assess students' performances in scientific process skills among primary school 6th, 7th and 8th grade students, a difference was found as per parents' status of education. Unlike these results, in a study conducted by Say and Tunç Şahin (2010) with primary school students, no differences were found among children's scientific literacy scores as per parents' status of education. Besides, in the study by Kesicioğlu (2008), it was found that there are no differences among children's attitude towards nature as per parents' status of education.

Another finding of the present survey is related to parents' occupational group. Statistically significant difference was found among children's science content standarts, physical sciences sub-dimension scores as per mothers' occupational group in favor of employees mothers in a public organization between housewife mothers and employees at a public organization mothers; in favor of worker mothers between worker mothers in a public organization and housewife mothers. It can be said that both employee mothers and worker mothers are more successful and conscious in supporting children's content



knowledge in physical sciences when compared with unemployed mothers. Although this finding of the study show consistency with results of the research conducted by Aydınli (2007) with 6th, 7th, 8th grade students in which a difference was found among students' scores in scientific process skill performance as per mothers' (father, different from this research) occupational group; besides, this findings is associated, despite not directly, with results of the study conducted by Kesicioğlu (2008) in which natural environment experiences offered to children by families vary in favor of mothers employees in a public organization, and different from in the present survey, vary in favor of fathers. In the present study, no statistically significant differences were found in children's science standards total and sub-dimension scores as per father's occupational group. It is a pleasing situation that father's profession makes a difference in children's science content knowledge, because father's profession is one of factors that describe the largest portion of inequality in education from the point of science tests applied on children according to data from Republic of Turkey State Planning Organization and World Bank Welfare and Social Policy Analytical Work Program (2010) that is similar to this study. In a study conducted with 580 parents of students who attend secondary school by Aksu and Karaçöp (2015), it has been determined that parents' active participation to children's home-based science learning activities and their efforts towards improving themselves in participation vary significantly in favor of employee in a public organization parents compared to other occupational groups. Findings of this study show parallelism with results obtained by Aksu and Karaçöp (2015) despite not being directly related.

### **Limitations and Future Directions**

In the present study, children's science content knowledge are examined in terms of variables related to child and parents. Due to the lack of study directly related to the subject of survey, findings are interpreted by comparing with similar research findings. In subsequent studies, similar studies in different regions may be carried out, and these studies can be compared with results of this study. Children's levels of having science content knowledge may be analyzed from the point of variables that include teachers' interaction behaviors with children during science activities and factors related to teacher such as creativity and personality traits, and longitudinal studies can be carried out.

### **Disclosure statement**

No potential conflict of interest was reported by the authors.

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