



IDEAS OF KINDERGARTEN STUDENTS ON THE DAY-NIGHT CYCLES, THE SEASONS AND THE MOON PHASES

(OKULÖNCESİ ÖĞRENCİLERİNİN GECE-GÜNDÜZ, MEVSİMLER VE AY'IN
EVRELERİ KAVRAMLARINA İLİŞKİN FİKİRLERİ)

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ABSTRACT

The aim of this study is to determine ideas of the kindergarten students on day-night, seasons, and the phases of the Moon. Although there are lots of studies on kindergarten students about science education, few of them are present on astronomy. Fifty-two students (age 6) from four different kindergartens were chosen as a sample of the study. The data were collected by using a semi-structured individual interview protocol. The results of the study revealed that kindergarten students have some sort of misconceptions on each concept. Individual interviews with kids show that students get these conceptions from their families, everyday experiences and their observations

Keywords: Kindergarten students, day-night, seasons, Moon phases, misconceptions

ÖZ

Bu çalışma ile okulöncesi öğrencilerinin gece gündüz, mevsimler ve Ay'ın evreleri ilgili fikirlerinin ortaya çıkarılması amaçlanmıştır. Alanyazında okulöncesi öğrencileri ile ilgili yapılmış birçok çalışmaya rastlanmasına rağmen bu çalışmaların çok azı astronomi ile ilgilidir. Bu araştırma Türkiye'de okulöncesi öğrencilerinin astronomi kavramlarını ortaya çıkarmaya yönelik yapılan ilk çalışmadır. Çalışmanın örneklemini 4 farklı anaokulundan seçilen 52 (6 yaş grubu) öğrenci oluşturmaktadır. Veri toplama aracı olarak yarı yapılandırılmış görüşme kullanılmıştır. Çalışmanın sonuçları okulöncesi öğrencilerinin her bir kavrama dair çok çeşitli fikirlere sahip olduğunu göstermektedir. Okulöncesi öğrencileri astronomi kavramlarına ilişkin formal bir eğitim almadıkları için öğrencilerin fikirleri naif fikirlerdir. Görüşmelerde okulöncesi öğrencileri bu kavramları ailelerinden, günlük deneyimlerinden ve gözlemlerinden öğrendiklerini belirtmiştir.

Anahtar Sözcükler: Okulöncesi öğrencileri, gece-gündüz, mevsimler, Ay'ın evreleri, kavram yanılgıları

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INTRODUCTION

Studies related to the process of students' perceptions and constructions of the environment point out that students can construct their observations and experiences in their mind to be either correct or incorrect. Mental models that are constructed by students and that contradict scientific facts are called "misconceptions," "alternative ideas," "students' science" etc. in the literature. Students' views are affected by experiences based on direct participation or observation, culture, language, explanations of teachers, and educational tools (Wandersee, Mintzes, & Novak, 1994:188).

Since kindergarten students have not generally had an instruction on the topic, they get the concepts from everyday experiences, from their daily observations, and from their interactions with grown-ups (Hannust and Kikas, 2007). Kindergarten students enter into the classroom after getting a certain perception level based on experiences till the age of six when the formal education starts (Nuutinen, 2005). Paik, Kim, Cho and Park (2004) found out that kindergarten students try to comprehend the changes of state of events through their sensorial observations without developing a full understanding level of the events. As a result, mental models developed by students may cause misconceptions. The education given by the family is no doubt one of the factors that effects the mental models developed by the students and should not be underestimated. The status and the way of life of the family where a student grows up affect the willingness of the students towards participation in school activities and his/her taking initiative (Arabacı and Aksoy, 2005).

There are many studies on science education that have been conducted with kindergarten students. For example, Ravanis and Bagakis (1998) studied understanding level of vaporization concept in Greece; Leighton (2003) looked for the ratio of awareness about ozone layer and the hole in it in Canada; and Paik et al. (2004) searched for ideas about change of state and necessary conditions for change of state in South Korea; Ravanis (2004) studied on mental models about frictional force in Greece; Nuutinen (2005) analyzed conceptual changes on sinking and floating concepts in Finland; Güler and Akman (2006) have determined views of 330 kindergarten students on the nature of science in Turkey.

It is not surprising that kindergarten students have numerous views on astronomy, which is a field based on observation (Baxter, 1991), because they can observe the day-night cycle, the movements of the Sun, the phases of the Moon and the stars (Urll, 2003). In spite of these results there are very few studies on the subject of astronomy done with kindergarten students (Vosniadou and Brewer, 1992; Vosniadou and Brewer, 1994; Valanides, Gritsi, Kampeza, and Ravanis, 2000; Hannust and Kikas, 2007). There are,

however, many studies with other age groups. For example, Baxter (1989, 1991), Sharp (1996), Dunlop (2000), Barnett and Morran (2002), Dove (2002) studied with primary school students (7-14 aged); Baxter (1989), Sadler (1992), Trumper (2001a) and Agan (2004) targeted high school students (15-18 ages) and Bisard, Aron, Francek and Nelson (1994), Atwood and Atwood (1997), Zeilik (1998), Trumper (2001b), Suzuki (2003), Kikas (2004), Küçüközer (2007), Trundle, Atwood and Christopher (2007) choose university students and prospective teachers to work with; Parker and Heywood (1998), Trumper (2001b), Kikas (2004) on the other hand preferred work with teachers on astronomy and astronomy related subjects. All of these studies show that students from different age groups have many ideas about the phenomena and concepts of astronomy. Some of these ideas are misconceptions and some of the misconceptions are common at different age groups. As mentioned above, studies on how kindergarten students perceive astronomical concepts are very few. Views of kindergarten students on day-night, gravity, the shapes and sizes of the Sun and the Earth have been analyzed in several studies (Vosniadou and Brewer, 1992; Vosniadou and Brewer, 1994; Valanides et al., 2000; Hannust and Kikas, 2007). Vosniadou and Brewer (1994) have worked with 20 students at the age of 6 years and 9 months. These students were at elementary school in the USA but they were at the same age with our study's sample and didn't have instruction about the subject. The study was about children's concepts on 'disappearance of the Sun at night', 'explanations of the day/night cycle', 'movement of the Moon' and 'disappearance of the stars during the day'. Thirteen first-grade children provided initial models, 2 children's models were synthetic models and only 2 children gave correct answer about the day/night cycle. Some of the children's initial models about the day/night cycle are 'the Sun goes down on/in the ground and the Moon comes up', 'the Sun goes down under the Earth or the other side of the Earth' and 'the Sun goes down it goes to another city'. Researchers obtained same ratio about the answers at the other questions.

In another study Vosniadou and Brewer (1992) worked with the same sample about mental models of the Earth's shape. Most first-grade students held a dual earth mental model or a mixed model and only 3 students gave the correct answer. Other models about the Earth's shape were that it is a hollow sphere, flattened sphere and rectangular Earth.

Valanides et al. (2000) worked with 33 kindergarten students in Greece and studied what they know about the shapes of the Sun and the Earth and how they perceive the concept of the day-night cycle. Although most of the students stated that before and after instruction, the Sun and the Earth's shapes is sphere, few described their shapes as hemispherical, disk-like, cubic or pyramidal. The misconceptions seen before the instruction on the day-night cycle were 'the Earth's revolving around the Sun and on its axis', 'the Earth's revolving around the Sun', 'the movement of the Sun' and 'religious' or

‘mythological explanations’. Although these misconceptions were still reported after the instruction, the ratio was relatively reduced.

Hannust and Kikas (2007) worked with 113 kindergarten students in Estonia and investigated the concepts of gravity and the shape of the Earth. They come across similar misconceptions about the shape of the earth as was found by Valanides et al. (2000). Most of the students showed the direction of the gravity to be downwards on their drawings. Interviews before and after the instruction revealed that students had many misconceptions on these concepts before the instruction, and kept most of them afterwards as well. Results revealed that the instruction was very complicated for the students, and therefore they still used alternative ideas that they constructed on their own to explain the events even after the instruction.

The Aim and Importance of the Research

This study aimed to investigate the ideas of kindergarten students on the day-night cycle, the seasons and the phases of the Moon. It should be noted that since they had no formal instruction beforehand, the views of the students were expected to be naive ideas based on self-observations, experiences, and their families’ contributions.

After a review of the literature, it is apparent that even though there are few studies on ideas of kindergarten students about astronomical concepts there has been no research conducted on this subject in Turkey. Therefore, this work reveals for the first time the views of Turkish kindergarten students on astronomical concepts.

METHODOLOGY

In this study a qualitative approach (interview) was used to understand and describe students’ ideas about astronomical concepts. Qualitative methods were used because they have the ability to better understand and describe the students’ understanding about these concepts.

Sampling

The sample consists of 52 kindergarten students. The sample of the study had been chosen from four different kindergartens located in the city centre of Balıkesir, and while three of them were public schools, one of them was private school. All of the students were six years-old. These kindergarten students had no instruction on astronomical subjects before this study. During the conversations kindergarten teachers said the sampling were not instructed about the concepts of the study before this study.

Data Collection and Analysis

While preparing the interview questions, we took ideas from some of the studies in the literature. The questions used in the studies of Küçüközer (2007), Trumper (2001a) and Zeilik (1998) about the day-night cycle, the seasons, and the phases of the Moon were helpful in preparing the interview questions.

After preparation, the questions were checked by one science education expert and five physics education experts for content validity. Necessary amendments suggested by experts for the questions which were used during the interviews were included to make them easier to understand for kindergarten students. Semi-structured individual interviews in a relaxed atmosphere lasted four weeks with each one taking around 20 minutes. During the interviews the students were asked:

- Why day-night take place,
- Why the seasons occur and,
- The Moon appears crescent during some nights, half during some other nights and full during some nights (the phases of the Moon were shown). What do you think what might cause these changes?

The data gathered through interviews were grouped and each group included similar explanations offered by the students and frequency values of these presented as tables. To offer examples, a couple of typical answers were chosen and given at the bottom of the tables.

RESULTS

The views of the kindergarten students on astronomical concepts revealed by the interviews are summarized in the subsequent sections.

Day-Night Cycle

In Table 1, the kindergarten students' ideas about the reasons for the day-night cycle are given.

28.9% of the students (15 students) offered scientifically acceptable explanations (the Earth spins on its axis) as the reason of day-night occurrence. Students in this category stated that the Earth revolves on its axis. As an example for this category the explanation of Student39 is given below:

Interviewer: How do day and night take place?

Student39: While it is night on the one side of the Earth it is daytime on the other side, when it becomes daytime on that side it becomes night on the other side.

Interviewer: How does this happen?

Student39: Because of Earth's revolving around itself.

Interviewer: Where did you learn all these?

Student39: My elder sister told me.

Table 1. The Ideas of the Kindergarten Students on the Reasons of the Day-night Cycle (n=52)

Ideas	Number of Students	Percent of Students (%)
The Earth spins on its axis*	15	28.9
Movement of the Sun**	10	19.2
Movement of the Moon**	7	13.5
Religious explanations**	5	9.6
Description of a situation**	4	7.7
Cloud**	3	5.8
The Moon has white face and black face**	1	1.9
Uncodable	4	7.7
No explanation	3	5.8

* correct idea, ** misconception

Eight students who gave the correct answer stated that they learned their answers from their family members such as from their mother, father, sister, aunt etc. as is the case with student39. A conclusion can be drawn from this outcome that although a kindergarten student who has not yet had a formal schooling, he or she can develop a correct mental model by means of his/her family.

The answers of 57.7% of all the students contradict with scientific facts. Among the wrong answers, the most frequent category is the ‘movement of the Sun’ with 10 students. In this category; four students offered the explanation that during the night the Sun goes to the space and comes back during the daytime, two students believed that the Sun revolves around the Earth and, the other four reported that the Sun was in a place where it was daytime and at nights it moved towards some other place where it was becoming daytime. One other wrong answer category is ‘movement of the Moon’ and there were seven students (13.5%) in it. These students reported that the Moon moves towards the place where it is night and at daytime it moves again towards some other places where it becomes night. As an example for this category, the dialogue with student26 is given below.

Student26: Day and night take place due to movement of the Moon.

Interviewer: How does the Moon move?

Student26: It revolves around us. The Moon sets, raises. When the Moon sets it becomes daytime, when it raises it becomes night.

As shown above, while the student26 has the accurate knowledge of the Moon’s orbit around the Earth, she links the day-night cycle with the appearances of the Moon and believes that these appearances cause the change from day-night.

There are five students (9.6%) who give answers that fall in the 'religious explanations' category. They are obviously influenced by their religious beliefs and said that the God (Allah) created day-night. There are three students (5.8%) in the 'cloud' category and they offer the explanation that clouds cause night by blocking the Sun. As a different category, only one student told that the Moon has two faces and day-night occurs because during daytime the Moon shows its white face, and during night it shows its black face. In the 'description of a situation' category four students linked day-night occurrences with their everyday life, and explained that night occurs to make people sleep, and daytime occurs to make them go to school.

Seasons

Table 2 shows the kindergarten students' ideas about that the seasons change. As shown in the Table 2, although students have various ideas about the changing of the seasons, none of them could offer a scientifically acceptable explanation of the tilt on the Earth's axis as the reason.

Table 2. The ideas of the kindergarten students on reasons of occurrences of the seasons (n=52)

Ideas	Number of Students	Percent of Students (%)
The Earth revolves around the Sun**	11	21.1
Life centric**	13	25
The movement of the Sun**	9	17.3
Clouds**	7	13.5
Religious explanations**	4	7.7
The distance of the Earth to the Sun**	2	3.9
Uncodable	2	3.9
No explanation	4	7.7

**misconception

The most frequent wrong answer (21.1% of students) is that because 'the Earth revolves around the Sun' the seasons occur. As an example to this category the dialogue with the student20 is given below.

Student20: There is an Earth and a Sun. When the Earth revolves around the Sun the seasons occur. The Sun is in the middle; as long as the Earth revolves around it different seasons take place.

Interviewer: Well why do you think so?

Student20: I have heard it before. It has been told that everything revolves around the Sun, the Earth too, my father once told me.

This example leads to a natural conclusion that while students make up their conceptual understanding their close environments influence them. In

this context it can be easily argued that whatever they learn from their families and friends becomes influential on their conceptual understanding.

Answers of 13 students (25%) fell into the 'life centric' category. While 10 of these students offered an explanation that the seasons occur in order to make fruits and vegetables, which grow in different seasons, grow, the other three kids said that they take place to make the summer hot and the winter cold. Under the category of 'the movement of the Sun', there are nine (17.3%) students' answers. They suppose that the Earth is stationary, and that the Sun revolves around the Earth. They explain this as follows, while the Sun revolves around the Earth, whichever side the Sun is on becomes summer for that side, and winter for the other side. When they were asked how they did get this knowledge they could not provide a satisfactory answer and said that "*it must be happen like this otherwise how can the seasons take place*". Seven (13.5%) pupils whose answers belong to the category of 'clouds' chose different ways to explain the effects of clouds on the occurrences of the seasons. While four of them said that clouds cause the seasons by blocking the Sun, the other three stated that dark and light-coloured clouds cause the seasons. The dialogue with student38 who saw colour of the clouds as the reason for the occurrences of the seasons is given below.

Interviewer: How do the seasons occur?

Student38: Due to the clouds.

Interviewer: Can you tell us more? How do the seasons occur due to the clouds?

Student 38: Due to dark clouds, white clouds. Due to dark clouds winter takes place; due to white clouds summer takes place. Because when there are dark clouds it becomes cold.

'The distance from the Earth to the Sun' is another category and only two students (3.9%) gave answers that can be put in this category. These students thought that the Earth is closer to the Sun during the summer and farther away during the winter.

Under the 'religious explanations' category, there are explanations of four students (7.7%). The dialogue with student23 in this category is given below.

Interviewer: How do the seasons occur?

Student 23: All have different specifications. God (Allah) tells when they should take place, the seasons occur.

Interviewer: How does God make the seasons occur?

Student 23: He calls one season's name and that season occurs.

As seen above, students in this category could not offer a scientifically acceptable explanation and they only used their religious beliefs for explanation of seasons

Moon Phases

It has been revealed that kindergarten students have quite a few ideas on the Moon phases. Accordingly the number of the categories designated to the answers turned out to be the highest. Table 3 shows the ideas of the students on the Moon phases.

Table 3. The ideas of kindergarten students on the Moon phases (n=52).

Ideas	Number of Students	Percent of Students (%)
The Moon revolves around the Earth*	4	7.7
Movement of the Sun**	8	15.4
Religious explanations**	7	13.5
Clouds**	6	11.5
There is more than one Moon in various shapes**	6	11.5
Movements of the Moon**	4	7.7
It changes because people want**	3	5.8
It changes according to seasons**	3	5.8
Stars joining in different shapes**	1	1.9
Uncodable	4	7.7
No explanation	6	11.5

* correct idea, ** misconception

Four students (7.7%) gave the correct answer and put in accurate answers category that argues the Moon rotates around the Earth. For an example, the dialogue with student31 who offered an accurate explanation is given below.

Student31: The Moon rotates around the Earth then Moon phases take place.

Interviewer: What happens when the Moon rotates around the Earth?

Student31: The Moon appears in various shapes.

Interviewer: How does the Moon appear in various shapes?

Student31: I would not know.

Even the students who gave right answer could not support their arguments with a scientific explanation. Based on students' responses it is evident that these students could not develop a complete understanding level for their answers.

Seventy-three percent of the students gave wrong answers, and the 'movement of the Sun' category has the highest ratio (eight students) of wrong answers. One student said that when the Moon is crescent the Sun is somewhere else, and two of them said that when the Sun moves to the place where it can see the Moon more and the Moon becomes full Moon. The remaining five argued that the Sun's whereabouts changes the shape of the Moon. After the Sun category the most frequent category is the 'religious explanations' category that included seven students (13.5%). As it happened for other questions some of the students were influenced by their religious beliefs and they said "God created the Moon phases". Under the category of

the ‘clouds’ there are six students (11.5%) who argued that by blocking the Moon different ways the clouds make the Moon appear in various shapes. Six students (11.5%) said that ‘there is more than one Moon in various shapes’ and explained the phases of the Moon with the appearance of one of these many moons on different nights. A record of the interview with student23 is given below.

Interviewer: When we look at the sky at different nights we see that the shape of the Moon changed. Why do you think the shape of the Moon changes?

Student 23: Sometimes it becomes like a banana, sometimes it looks like a football ball. There are two moons, one is banana shape, and the other one is a football ball shape. When they appear we see different.

As seen above, student23 told that there were two moons: one shaped like a banana, and the other one like a football ball, and they come out at different times. In the category of the ‘movements of the Moon’ four students (7.7%) assume that shape of the Moon changes because the Moon goes to a different place during the daytime. One student said that the phases of the Moon change according to the seasons.

CONCLUSION, DISCUSSION AND SUGGESTIONS

Since kindergarten students have had no instruction on astronomical subjects in school, the ideas that they develop by are based on their own perceptions of the environment (Hannust & Kikas, 2007). The kindergarten students’ responses to the questions in the interview reflect how they perceive the events and the world around them. In their explanations, they clarified how they perceive the events and they rationalized their accounts by their observations.

This study revealed that kindergarten students have various ideas, most of which are not accepted as scientifically accurate on the subjects of day-night, the seasons and Moon phases. These misconceptions,

- About Day-Night: ‘during the night the Sun goes to the space and comes back during the daytime’, ‘the Sun revolves around the Earth’, ‘the Moon moves towards the place where it is night and at daytime it moves again towards some other places where it becomes night’, ‘the God created day-night’, ‘clouds cause night by blocking the Sun’, ‘the Moon has two faces and day-night occur since during daytime it shows its white face and during night it shows its black face’ and ‘night occurs to make people sleep, daytime occurs to make them go to school’.
- About seasons: ‘the seasons occur because the Earth revolves around the Sun’, ‘the seasons occur in order to make fruits and vegetables, which grow in different seasons, summer hot and the winter cold’, ‘the Sun revolves around the Earth which side the Sun is it becomes summer for

that side and winter for the other side’, ‘clouds cause the seasons by blocking the Sun’, ‘dark and light-coloured clouds cause the seasons’, ‘the Earth is closer to the Sun during the summer and farther away during the winter’ and ‘God calls one season name and that season occurs’.

- About The Moon phases: ‘the Moon is crescent the Sun is somewhere else’, ‘the Sun moves to the place where it can see the Moon more than the Moon becomes full moon’, ‘the Sun’s whereabouts changes the shape of the Moon’, ‘the God created the Moon phases’, ‘the clouds make the Moon appear in various shapes’, ‘there is more than one moon in various shapes’ and ‘shape of the Moon changes because the Moon goes a different place during the daytime’.

The misconceptions, encountered, related to the concept of day-night that kindergarten students are the same that the concepts that Valanides et al. (2000) encountered. As stated above, there have been many studies done concerning older age groups other than kindergarten students that exposed these misconceptions. Some of these misconceptions are the same as those of our study. For example, Baxter (1989), Sharp (1996), Dunlop, (2000), Sadler (1992) have found clouds cause night by blocking the Sun misconception had been seen among primary and high school students as well. Zeilik (1998) came across the misconception that the Moon has two faces and day-night occur since during daytime it shows its white face and during night it shows its black face misconception during his study with university students.

To the best of our knowledge, there have not been done any studies with respect to kindergarten students’ ideas about the seasons and the moon phases in Turkey or other countries. This study revealed for the first time the ideas of kindergarten students about these concepts. But the misconceptions, shown in this study, have been found at other studies for the seasons and Moon phase’s concepts. Regarding seasons, at older age groups Baxter (1989), Sharp (1996) have found out that some primary school students show the changes on the plantations as the reason of occurrences of the seasons. Likewise Baxter (1989) and Sharp (1996) found out that primary school students had similar misconception that alleges clouds cause the seasons. The Earth is closer to the Sun during the summer and farther away during the winter misconception has been commonly seen among primary school, high school and university students and even among teachers as well (Baxter, 1989; Sharp, 1996; Dove, 2002; Sadler, 1992; Trumper, 2001a; Atwood & Atwood, 1997; Trumper, 2001b; Küçüközer, 2007; Parker & Heywood, 1998; Kikas, 2004). For the Moon phases, the same results were found at older age groups. The clouds make the Moon appear in various shapes’ misconception is present amongst primary-school students (Baxter, 1989; Sharp, 1996; Dunlop, 2000). The study also disclosed that kindergarten students have some misconceptions amongst

primary school, high school, and university students and even amongst teachers too. According to this result, it can be argued that the formal schooling is not particularly effective in overcoming these misconceptions.

Brickhouse, Dagher, Letts and Shipman (2000) stated that students are influenced by their religious beliefs when they explain scientific concepts. Likewise during the interviews at our study it has been observed that some of the kindergarten students were influenced by their religious beliefs in their answers. They say God is the reason for the occurrences of astronomical events. At Valanides et al'. (2000) study, two kindergarten students pointed to God as the cause of day-night occurrences and Küçüközer's (2007) study done with prospective science teachers, found out that 18% of his sample group believed that God created the universe. Some students at our study believe God to be the sole reason for occurrences of day-night, the seasons and the Moon phases. It is apparent that regardless of the age, religious beliefs have an effect on views of the students and teachers. It should be noted that kindergarten students will bring all these ideas that they have when they first come to school, and that these ideas will influence their further education.

In Turkey, kindergarten curriculum includes many concepts related to science education. Some of these concepts are electricity, the respiratory system, organs and astronomy. Astronomy concepts encompass the day-night cycle, the seasons, the Moon's motion and the Sun's affection. Thus, students' misconceptions in terms of these subjects are important, and activities that can promote conceptual change should be included. In the study of Valanides et al. (2000), they stated that activities done for promoting conceptual change are partly effective at these ages. For this reason, science education program about kindergarten should be oriented toward achieving conceptual change. In order to promote conceptual change and progress towards scientific knowledge, kindergarten teachers should put emphasis on and accentuate activities for advancing conceptual change in their programs. Astronomy education should start at the kindergarten level. Therefore kindergarten teachers should be trained and educated about these misconceptions and conceptual changes with in-service courses.

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