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Primary School Students' Knowledge On The Concept Of "Planet": A Survey Study

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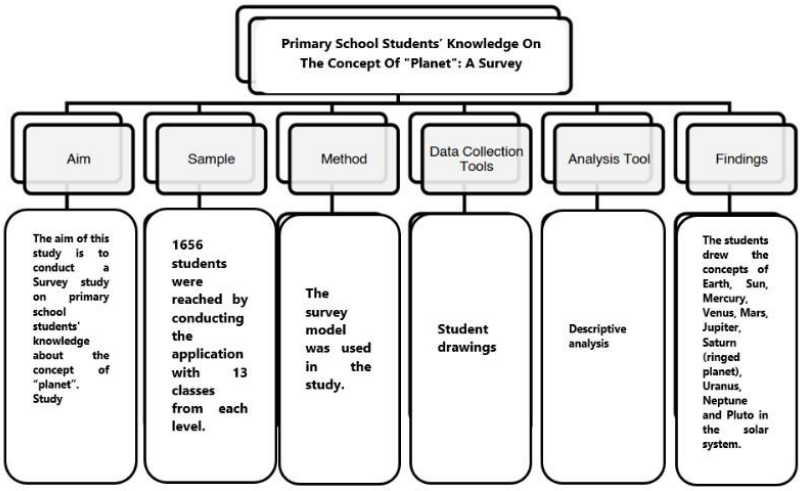

Abstract

The aim of this study is to conduct a survey study on primary school students' knowledge about the concept of "planet". The survey model was used in the study. The study was conducted in a primary school in a district with a low socioeconomic level in Istanbul. Within the scope of the study, a total of 1656 students were reached by conducting the application with 13 branches from each level. In the study, certain questions guided by the researcher were directed to the students to think and realize their drawings. They were given approximately 25-30 minutes for drawing. The drawings were evaluated using descriptive analysis method. Each drawing was analyzed separately. The concepts in the drawings were categorized as drawings related to the concepts in the solar system, drawings related to astronomy concepts, and drawings other than astronomy concepts. As a result of the coding, percentage frequency was determined according to the frequency of students' use of concepts at each level. In this context, it was determined that students in the first two levels made drawings and coding other than astronomy concepts, while students in the last two levels concentrated more on drawings and coding related to the concepts in the solar system and astronomy concepts.

Key words: Planet, Conceptual Knowledge, Science Education, Primary school students.

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Introduction

Science and technology literacy is the ability of all citizens in society to understand and explain some scientific concepts and phenomena at the most basic level and to have the ability to follow technological developments and use these concepts in their lives (Kamaraj, 2009). Science and technology literate individuals perceive the nature of science and scientific knowledge; understand basic science concepts, principles, laws and theories and use them in appropriate ways (Kavak, Tufan, & Demirelli, 2006). Considering the increase in the amount of information today, the need for technology and science has also increased. For this reason, it is important for individuals to be science literate at a basic level.

When the literature is examined, the concept of science literate started with the change in university curricula in 1997 and continued with the change in primary education curricula in 2004 (Özcan & Düzgünoğlu, 2017). Thus, science literate individuals can be more effective in accessing and using information, solving problems, making decisions about relevant problems by taking into account possible risks, benefits and available options, and producing new knowledge. In this sense, it should be aimed that each individual who is planned to be educated should actively experience this process and carry his/her concept knowledge to a different and improved step than the previous step.

The awareness of individuals who are expected to be science literate at many stages of their lives throughout their lives is directly proportional to their awareness of science subjects, self-development, and an active process both in their education and in all areas of their lives, and their early exposure to science (Kaya, 2017). In this context, encountering science at an early age and the differences that this process creates in the mind of the individual will help him/her learn by coding the concepts correctly.

In addition, factors such as students' daily experiences, belief systems, experiences gained in their social environments and their efforts to attribute meaning to concepts with their undeveloped mental skills contradict the nature of science and the process of formation of scientific knowledge. For this reason, these experiences of the students attribute wrong meanings to the concepts (Ercan, Taşdere, & Ercan, 2010). For this reason, it is important to reveal how these concepts are shaped in students' minds. One of the main goals of science education is to ensure that students learn concepts in a meaningful and permanent way (Köse & Uşak, 2006). Science course, which contains many abstract concepts, is very difficult to learn

and perceive at the conceptual level due to these abstract concepts. In the studies conducted by Ünsal, Güneş, and Ergin (2001), it was determined that students formed non-scientific concepts and that students at higher education level had some misconceptions. In this context, it is foreseen that astronomy teaching that is not based on a solid foundation at the primary school level creates a basis for misconceptions at the higher education level.

Teachers play an important role in raising students as science literate individuals. Teachers should guide and direct students in understanding science and integrating it into their daily lives, and in acquiring skills such as expressing their thoughts about science, decision making, critical thinking, etc. Again, the teacher should have sufficient knowledge about these cognitive steps that manage and develop the level of science literacy and manage this process competently (Kaya & Bacanak, 2013). In this direction, the way a teacher can assimilate a system that aims to raise science literate individuals is through being a science literate individual himself/herself (Aldan Karademir, 2012).

Another step taken towards effective and permanent teaching in science teaching is the change in the science curriculum in 2005. When this change is examined, the task of teachers is to help students understand the steps of the scientific process and to guide them in the process of gaining these steps (Lapadat, 2000); to reveal the knowledge that exists in the student and to guide him/her in the process. Lapadat (2000) emphasized that students experience a conceptual change process in their minds. In this process, conceptual changes occur and the student's mental knowledge and belief change are related to the words the teacher chooses while guiding the process. However, the operational process stage of the students' period is also one of the main factors that form the student's perception and the way he/she interprets information. The aim of the science course education, which includes concrete, complex and abstract concepts, is to ensure that the science course is transformed into something that can be made sense of by the students and, accordingly, to raise individuals who are inquisitive, inquiring and science literate (MoNE, 2013).

Using drawings to understand how children perceive astronomical concepts is an effective method, especially in the representation of celestial bodies such as the Sun. In a study conducted by Villarroel and Villanueva (2019), it was observed that children depicted the Sun with human features (e.g., facial expressions) in their drawings before observing the Sun with a telescope, but after the observation, these anthropomorphic features decreased and more

scientific representations emerged. This change indicates that children were able to internalize scientific concepts more accurately through direct observation. Therefore, this study is important in terms of determining students' conceptual knowledge and knowing their current level of knowledge in the education process they will receive at the next level. The aim of this study is to determine students' mental schemas related to the concept of “planet”.

The concept of planet is defined in the dictionary of the Turkish Language Association as "the common name of celestial bodies orbiting around the Sun and reflecting the light they receive from it" (TDK, 2005, p.378). Making guesses about the part we cannot see, that is, the part outside the Earth, is limited to what we see in the sky, especially for a student at primary school level. Moreover, since the concept of "planet" includes many abstract concepts, it becomes difficult to understand the concept of planet and similar concepts in the solar system. However, in this century, which is called the age of science and technology, the boundaries of knowledge are expanding day by day, the number of sources of information is gradually increasing, and access to information is reaching a dimension that we can access at any time (Yenca, 2016). For this reason, the students were guided with the questions asked and allowed to imagine the concepts that remained abstract because they could not see them. According to the interests of children at this age, cartoons, videos, visuals in books and science centers they have visited help them to form their concept knowledge.

Methods

Research Model

Survey model, one of the descriptive research methods, was used in the study. The survey model, which is one of the descriptive research methods, is a model that aims to describe the current situation as it existed in the past or currently exists (Karasar, 2005). In survey studies, the larger the sampling, the less the possible generalization error (Karasar, 2005). Within the scope of this study, a large sample was tried to be reached in order to describe the current situation.

Participants

The study was conducted in a primary school with a low socioeconomic level in Sultanbeyli district of Istanbul. In the school where the study was carried out, there are 2330 students, including 24 branches at the first grade level, 28 branches at the second grade level, 23

branches at the third grade level, and 20 branches at the fourth grade level. Within the scope of this study, the application was carried out with 13 sections each at the 1st, 2nd, 3rd and 4th grade levels. A total of 1656 students were reached, including 379 students from the first grade, 414 students from the second grade, 430 students from the third grade and 433 students from the fourth grade.

Data Collection Tools

This study aimed to reveal students' existing conceptual knowledge about the concept of "planet". Student drawings were used as data collection tool. During the application, students were asked to draw what they visualized in their minds about the concept of "planet". It was ensured that the students carried out the drawing application individually. Meanwhile, in order for the students to focus on the concept of "planet", the researcher asked them questions (What is a planet? What are their characteristics, what do they look like? Do you think there is only one planet? Are there more than one planet? If more than one, are they similar to each other? Where are the planets?) were asked. While the questions were being asked, students were asked to close their eyes and focus only on the teacher's questions and think. Students were given approximately five minutes for thinking.

Data Analysis

At the end of the application, the pictures drawn by the students were evaluated within the scope of this study. The pictures were evaluated using the descriptive analysis method. Each drawing was analyzed separately. The concepts in the drawings were divided into separate headings as "drawings related to the concepts in the solar system", "drawings related to astronomy concepts" and "drawings other than astronomy concepts". Based on the pictures, separate criteria were determined and the pictures were coded under these criteria. The coding was done separately by two researchers and continued until a common point was reached.

Results

Based on the drawings, the findings were evaluated in the context of the drawings of the concepts in the solar system. When the student drawings were analyzed, it was determined that the students drew the concepts of Earth, Sun, Mercury, Venus, Mars, Jupiter, Saturn (ringed planet), Uranus, Neptune and Pluto in the solar system. Drawing examples for each concept

were categorized according to their main characteristics such as drawing the concept, naming it correctly, and drawing more than one concept.

Findings Related to the Concept of World

Students' drawings were analyzed and as a result of the evaluation of the drawings, criteria for the concept of the world were determined by the researcher. In line with these criteria, student drawings were coded and analyzed. As a result of this coding, the world drawings at each level were evaluated separately. The criteria determined and the data obtained are given in Table 1.

Table 1. World concept drawings

	Classes (f)				
	1st Grades	2nd Grades	3rd Grades	4th Grades	Total
World drawings	67	201	313	280	861
Pictures where the world is drawn more than once	11	14	16	10	51
Pictures in which the proportion of the size of the world is drawn correctly	3	4	8	50	65
Pictures where the world drawing is named correctly	60	170	281	248	759
Pictures indicating continents in world drawing	31	17	108	173	329
Pictures showing the layers of the earth	2	1	20	0	23
Pictures showing the orbit of the Earth	1	4	7	22	34

When Table 1 is analyzed, it is seen that a total of 861 students drew the world in their drawings. 795 students did not draw a world. While 810 students indicated the concept of the world as a single concept in their drawings, 57 students drew the world more than once in their drawings. An important situation that draws attention in students' drawings is that the proportion of the size of the world is not drawn correctly by most students. Only 65 students drew the proportion of the size of the world correctly. Almost all of the students (f=759) named the drawn world pictures correctly. Approximately 50% of the students who drew the world (f=329) drew the world by indicating its continents. In the drawings of the world, students at the 3rd and 4th grade level stated that the Earth has an orbit and continues its movement according to this orbit. Examples of World pictures drawn by students from different grade levels are given in Figure 1. While sharing examples of student drawings, care was taken to include the drawings of students from all levels.

Figure 1. Examples of World drawing

Findings related to the concept of Sun

As a result of the findings obtained from the drawing studies, different criteria for the concept of Sun were determined and these criteria were divided into separate headings. These criteria and the data obtained are given in Table 2.

Table 2. Drawings of the Sun concept

Sun Concept	Classes(f)				
	1st Grades	2nd Grades	3rd Grades	4th Grades	Total
1. Sun drawings	208	202	256	248	914
2. Those who draw the correct proportion of the size of the sun	5	7	9	78	99
3. Those with more than one sun drawing	12	14	10	7	43

When Table 2. is analyzed, a total of 914 students, 208 of whom were in the first grade, 201 in the second grade, 256 in the third grade and 248 in the fourth grade, included the Sun in their drawings. 742 students did not draw the Sun. An important finding is that most of the students could not draw the size of the sun correctly. . Examples of drawings from different grade levels that include the sun are given in Figure 2.

Figure 2. Examples of sun drawings

Findings Related to the Concept of Mercury

Students' drawings were analyzed and as a result of the evaluation of the drawings, the criteria given in the table were determined for the concept of Mercury. Student drawings were coded and analyzed in line with the determined criteria. As a result of this coding, Mercury drawings at each level were evaluated separately. The data obtained are given in Table 3.

Table 3. Mercury concept drawings

Mercury Concept	Classes(f)				
	1st Grades	2nd Grades	3rd Grades	4th Grades	Total
1. Mercury drawings	0	5	36	23	54
2. Those who correctly draw the proportion of the size of Mercury	0	0	1	7	8
3. Those with more than one Mercury drawing	0	0	1	0	1
4. Those circling Mercury	0	4	2	3	9

When the table is analyzed, there were no students who drew Mercury at the first grade level, while 5 students at the second grade level, 36 students at the third grade level and 23 students at the fourth grade level included Mercury in their drawings. In total, 54 students drew Mercury, while the concept of Mercury was not encountered in the drawings of 1602 students. . Examples of Mercury drawings from different grade levels are given in Figure 3.

Figure 3. Examples of Mercury drawings

Findings Related to the Concept of Venus

Criteria for the concept of Venus were determined by the researcher and student drawings were coded and analyzed in line with the determined criteria. As a result of this coding, Venus drawings at each level were evaluated separately. The data obtained are given in Table 4.

Table 4. Venus concept drawings

Venus Concept	Classes(f)				
	1st Grades	2nd Grades	3rd Grades	4th Grades	Total
1. Venus drawings	2	13	41	63	119
2. Those who named the concept of Venus correctly	2	13	37	61	113
3. Those who drew a ring around Venus	0	9	6	16	31
4. Those with more than one Venus drawing	0	1	1	4	6

When Table 4 is examined, a total of 119 students, mostly upper grades, drew Venus and named it correctly. 1537 students did not include Venus in their drawings. Venus pictures drawn by students from different grade levels are given in Figure 4.

Figure 4. Examples of Venus drawing

Findings Related to the Concept of Mars

Students' pictures were analyzed and criteria were determined. Student drawings were coded and analyzed in line with the determined criteria. As a result of this coding, Mars drawings at each level were evaluated separately. The data obtained are given in Table 5.

Table 5. Mars concept drawings

Mars Concept	Classes(f)				
	1st Grades	2nd Grades	3rd Grades	4th Grades	Total
1. Mars drawings	2	23	53	92	170
2. Those who can name the concept of Mars correctly	0	16	39	82	137
3. Those who drew a ring around Mars	0	5	13	11	29
4. Those with more than one Mars drawing	0	1	2	2	5

When Table 5 is analyzed, it is seen that a total of 170 students, including two first-grade students, 23 second-grade students, 53 third-grade students and 92 fourth-grade students, drew Mars in their drawings. 1486 students did not draw Mars in their drawings. Pictures of Mars drawn by students from different grade levels are given in Figure 5. While sharing examples of student drawings, care was taken to include the drawings of students from all levels.

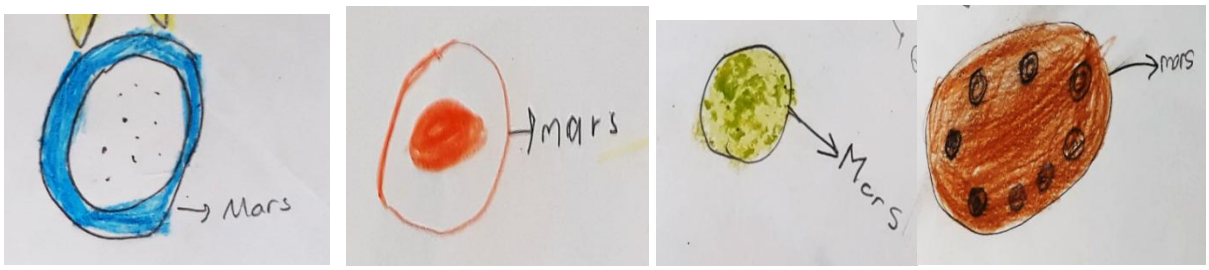

Figure 5. Examples of Mars drawing

Findings Related to the Concept of Jupiter

As a result of the evaluation of the pictures, criteria were determined by the researcher for the concept of Jupiter. In line with the determined criteria, student drawings were coded and

analyzed. As a result of this coding, Jupiter drawings at each level were evaluated separately. The data obtained are given in Table 6.

Table 6. Jupiter concept drawings

Jupiter Concept	Classes(f)				
	1st Grades	2nd Grades	3rd Grades	4th Grades	Total
1. Jupiter Drawings	3	6	44	72	125
2. Can name the concept of Jupiter correctly	3	6	44	72	125
3. Those who drew a ring around Jupiter	2	2	17	29	50
4. Those with More Than One Jupiter Drawing	0	0	3	1	4

When Table 6 is analyzed, it is seen that a total of 125 students, mostly fourth grade students, included Jupiter in their drawings. 1531 students did not draw Jupiter. At the first and second grade levels, no student drew more than one Jupiter. Three students in the third grade and one student in the fourth grade drew more than one Jupiter. Examples of student drawings are shown in Figure 6.

Figure 6. Jupiter Drawing Examples

Findings Related to the Concept of Saturn

In line with the determined criteria, student drawings were coded and analyzed. As a result of this coding, Saturn drawings at each level were evaluated separately. The data obtained are given in Table 7.

Table 7. Saturn concept drawings

Saturn Concept	Classes(f)				
	1st grades	2nd grades	3rd grades	4th grades	Total
1. Saturn Drawings	9	29	47	110	195
2. Those who can name the Saturn drawing correctly	3	10	24	34	71
3. Those who drew a ring around Saturn	7	23	40	100	170
4. Those with More Than One Saturn Drawing	1	0	1	1	3

When Table 7 is analyzed, it is seen that a total of 195 students drew Saturn in their drawings and 1461 students did not draw Saturn. Seven students in the first grade, 23 students in the second grade, 40 students in the third grade and 100 students in the fourth grade drew rings around Saturn. In some drawing examples (first grade f=2, second grade f=9, third grade f=9, fourth grade f=22), Saturn was even named as a ringed planet. Examples of student drawings are shown in Figure 7.

Figure 7. Examples of Saturn drawings

Findings Related to the Concept of Uranus

Student drawings were coded in line with the determined criteria and the data obtained are given in Table 8. When Table 8 is analyzed, no Uranus drawing was found at the first and second grade levels. A total of 37 students, including 17 third-grade and 20 fourth-grade students, drew Uranus in their drawings. 1619 students did not draw Uranus. Examples of student drawings are shared below.

Table 8. Uranus concept drawings

Uranus concept	Classes (f)				
	1st Grades	2nd Grades	3rd Grades	4th Grades	Total
1. Uranus Drawn Pictures	0	0	17	20	37
2. Name the Drawing of Uranus Correctly	0	0	16	14	30
3. Ring Around Uranus	0	0	3	1	4

Figure 8. Examples of Uranus drawings

Findings Related to the Concept of Neptune

Student drawings were coded and analyzed in line with the determined criteria. The data obtained are given in Table 9. When the table is analyzed, it is seen that very few students included Neptune in their drawings. 1613 students did not draw Neptune. Examples of student drawings are given below.

Table 9. Neptune concept drawings

Neptune Concept	Classes (f)				
	1st grades	2nd grades	3rd grades	4th grades	Total
1. Neptune drawings	0	1	17	25	43
2. Name the Neptune Drawing Correctly	0	1	17	18	36
3. Ring Around Neptune	0	0	2	1	3

Figure 9. Examples of Neptune drawings

Findings Related to the Concept of Pluto

Student drawings were coded and analyzed in line with the determined criteria. The data obtained are given in Table 10.

Table 10. Pluto concept drawings

Pluto Concept	Classes(f)				
	1st Grades	2nd Grades	3rd Grades	4th Grades	Total
1. Pluto Illustrations	0	0	6	15	21
2. Name the Pluto Drawing Correctly	0	0	6	14	20
3. Those who drew a ring around Pluto	0	0	0	1	2

When the table is analyzed, no Pluto drawing was found at the first and second grade levels. Of those who drew Pluto, a total of 21 students, 6 in the third grade and 15 in the fourth grade, included Pluto in their drawings. 1635 students did not draw Pluto. Examples of Pluto pictures drawn by students from each grade level are given in Figure 10.

Figure 10. Pluto drawing examples

Discussions, Conclusions and Recommendations

The main purpose of this study is to determine the existing conceptual knowledge of primary school students about the concept of "planet" through a survey study. In the light of the findings obtained as a result of the drawing studies carried out for this purpose, the concepts of sun and earth, which have a large place in the curriculum, were frequently encountered in the drawings made by the students. In the findings related to the solar system, the frequency of the concept of the sun increased in the drawings of students in the third and fourth grade levels, while the value of this frequency decreased in the first and second grade levels.

Children's misconceptions about astronomy concepts and revealing these misconceptions through drawing methodologies have taken an important place in educational research in recent years. In particular, children's perceptions of the shape and structure of the Earth are often represented by a flat or hollow Earth model. However, research by Nobes and Panagiotaki (2008) suggests that such misconceptions may result from the ambiguity of the drawing and questioning methods used. These findings suggest that the non-scientific representations seen in children's drawings may in fact be due to the complexity of the tasks and the inadequacy of the instructions.

When the findings regarding the planets in the solar system are analyzed; Earth drawings were found at every grade level. In addition, elaborations such as the continents on the Earth, the layers of the Earth, the Earth's orbit, the proportion of the size of the Earth compared to other planets in the Solar System were found in drawings made at all grade levels. Although 102 of the 861 students who drew the Earth drew the Earth, they could not name it. This shows that students have a concept of Earth in their minds visually, but they have problems in naming it.

The second most common concept in the drawings and drawn at all levels is the sun. This is not the case for many other planets. Drawings of other planets were not found at every grade level. In addition, it was determined that the number of drawings with direct proportion and names was very low. This is a striking result. In a study conducted by İnaltekin and Akbaba (2024), 8th grade students' models of astronomical events and the information sources of these incorrect models were examined. The study revealed that most of the students had incorrect models on topics such as “Solar Eclipse”, “Lunar Eclipse”, “Phases of the Moon”, “Formation of Seasons” and “Day-Night Formation”. Moreover, teachers and textbooks are among the most common sources of information for these false models.

Galano and Testa (2025) investigated the effects of an approach combining hands-on activities and visual representation methods to increase students' understanding of seasonal changes. The study showed that when hands-on activities and specially designed visuals were used together, students' understanding of seasonal changes became more accurate and their misconceptions decreased.

In the study conducted by Balcı & Yıldırım (2019), drawings were made to reveal primary school students' perceptions about “World and Universe”. It was concluded that the students who

made the drawings had a perception that was far from scientific. This situation shows a similar result in this study. For example, the fact that many planets were drawn as rings and very few drawings included sizing and ordering leads us to this conclusion.

Bostan (2008) aimed to investigate students' ideas about basic astronomy concepts and events in a study conducted with different age groups (from fourth grade in primary school to fourth grade in university). In this context, he investigated students' knowledge levels about basic astronomy concepts and events (seasons, day and night, the center of the universe, the reason why stars are not visible during the day, the brightest star in the night sky, the phases of the Moon, the positions of the Moon, Earth and the Sun during a lunar eclipse, shooting stars, and the frequency of eclipses). As a result of the study, it was observed that some misconceptions decreased with advancing age, while some misconceptions increased with advancing age. Similarly, studies conducted in Turkey reveal that students have various misconceptions about the basic concepts of astronomy.

Serttaş and Yenilmez Türkoğlu (2020) found that 7th grade students defined the universe as "the space outside the Earth" and perceived comets as "stars falling from the sky". Concept cartoons, which are used to detect such misconceptions, are used as an effective tool to reveal students' existing knowledge structures and misconceptions.

Conflict of Interest Statement

The authors of the article declare that there is no conflict of interest between them.

Summary of Contribution Rate Declaration of Researchers

The authors declare that they have contributed equally to the article.

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