European Journal of Education Studies
ISSN: 2501 - 1111
ISSN-L: 2501 - 1111
Available on-line at: www.oapub.org/edu

doi: 10.5281/zenodo.846463 Volume 3 | Issue 9 | 2017

EXAMINATION OF THE TRANSFER OF ASTRONOMY AND SPACE SCIENCES KNOWLEDGE TO DAILY LIFE

Nuri Emrahoğlu[i]
Çukurova University,
Faculty of Education,
Turkey

Abstract:
In this study, it was aimed to determine the levels of the ability of science teaching fourth grade students to transfer their knowledge of astronomy and space sciences to daily life within the scope of the Astronomy and Space Sciences lesson. For this purpose, the research method was designed as the mixed method including both the quantitative and qualitative process, and the sample of the study consisted of 65 students selected with criterion sampling and easily accessible sampling method. The Astronomy and Space Sciences Knowledge Test (ASSKT) was used in order to measure the students' knowledge of astronomy and space sciences, and the Transfer of the Astronomy and Space Sciences Knowledge to Daily Life Interview Form (TASSDLIF) was used in order to determine the transfer of the astronomy and space sciences knowledge to daily life. The state of the correlation between the ASSKT and TASSDLIF scores of the students was determined in the quantitative part of the study and the levels of students' ability to transfer the subjects of astronomy and space sciences to daily life were determined in the qualitative part. As a result of the study, a significant, positive and weak level of the relationship was determined between the ASSKT and TASSDLIF scores. It was concluded that there were zero transfer, incomplete transfer and full transfer in the students' states of the ability to transfer their knowledge of astronomy and space sciences to daily life. The subjects with the highest full transfer are "Finding Directions, Telescopes, and Gravity", while the subjects with the lowest full transfer are the "Star Distances, Conception of the Universe, and Earth's Crust".

Keywords: astronomy and space; daily life; constructivism

[i] Correspondence: email emrahoglu@gmail.com

1. Introduction

Throughout the years, astronomy and space sciences have been among the subjects that human beings have wondered and been interested at most. Humans' interest in the sky leads them to observe, examine and question the sky. While many events that take place in the sky, the phases of the Moon, eclipses, falling of the star, the sunrise and sunset, etc. have changed the beliefs, economic activities and lifestyles of people, they also have ensured that the findings in this respect are examined and recorded in a more detailed way (Unat, 2001; Kalkan, Ustabaş & Kalkan, 2007). This situation has led to the rapid increase in information, its association with different disciplines (such as physics, chemistry, and biology), its use in different contexts, and also the necessity of scientific thinking skills. For this reason, the aim of teaching the subjects of astronomy and space sciences should be to raise individuals who have internalized that the science of astronomy is life itself, can solve the problems they encounter by using scientific methods, associate what they learn with daily life, and are productive (Düşkün, 2011; Kalkan, Ustabaş & Kalkan, 2007).

For the purpose of achieving this aim at the educational levels, constructivist learning activities should be primarily included (Kılıç, Karadeniz & Karataş, 2003). The constructivist approach is an approach that guides students' thoughts rather than transferring knowledge and enables them to research, question, and associate the knowledge with daily life (Vermette & Foote, 2001). The application of the constructivist approach in astronomy and space sciences provides the knowledge transfer to daily life and in other contexts. Knowledge transfer is defined as the ability to apply the learnings acquired with past experiences to new situations and problems (Etkina, Karelina & Villasenor, 2006) and the ability to apply and use knowledge in a different or similar area (McKeachie, 1987). In this context, the curriculum of physical sciences (physics, chemistry, biology) (MNE, 2009) and astronomy and space sciences centered on the constructivist approach emphasizes the problems of zero and incomplete knowledge transfer (MNE, 2010). However, the aim in educational systems is the realization of the full transfer in learning. Upon examining the related literature in this context, the states of the transfer of knowledge to daily life in physics subjects (Balkan; 2008; Etkina, Karelina & Villasenor, 2006; Yılmaz, 2008) and physical science subjects (Fortus, Krajcik, Dershimer, Lee & Lıu, 2009) were investigated. Upon examining the relevant literature within the scope of astronomy and space sciences, it was determined that the studies conducted were related to astronomy concepts, misconceptions (Bekiroğlu, 2007; Cin, 2007; Kikas, 2004; Trundle, Atwood & Christopher, 2007), and mental model determination in astronomy (İyibil & Arslan Sağlam, 2010; Panagiotaki, Nobes & Potton, 2008). In this context, a study on the

association of astronomy and space science subjects with different contexts and their transfer to daily life will contribute to the field in terms of determining the adequacy of the information learned and taking precautions against situations that are fallen short. For this purpose, the states of associating the knowledge of science teaching final grade students acquired in the course of "Astronomy and space sciences" with different contexts and determining the levels of associating depending on this formed the main aim of the study and answers to the following questions were sought:

1. Is there a significant relationship between the achievement scores of astronomy and space sciences and the scores of the transfer of astronomy and space sciences knowledge to daily life?
2. At which level has the ability to transfer astronomy and space sciences knowledge to daily life been realized in students?

2. Method

This section contains information about the research model, study group, data collection tools, data collection, and the techniques used in the data analysis.

2.1. Research Model

The study is a mixed method study for determining the association of the information acquired in the course of astronomy and space sciences at university levels with different contexts. The mixed method is the research in which research problems and questions are examined in more detail by combining or blending the qualitative and quantitative research methods (Cresswell, 2013). In this study, the quantitative dimension comprises of the information test, and the qualitative dimension comprises of the levels of transfer to daily life.

2.2. Study Group

The study was carried out in the spring semester of the 2014-2015 academic year, at a university in the south of the country with 65 fourth-grade students studying science teaching. In determining the sample in the study, the easily accessible sample was used since it was close to the researcher and easy to access, and the criterion sampling was used since the students took the course of modern physics/astronomy and space sciences. Upon examining the academic achievements during the undergraduate education of the students, it was also determined that the achievements were moderate.

2.3. Data Collection Tools

In the study, the Astronomy and Space Sciences Knowledge Test (ASSKT) developed by Taşcan (2013) was used to determine the students' academic knowledge and achievements in astronomy and space sciences. When the knowledge test was examined statistically, it was determined that it comprised of 21 items, its mean difficulty (pj) was 0.446, the distinctiveness (rjx) was 0.512, and the reliability was 0.73. For the content validity, opinions of two experts, who are experts in their fields and have many studies on this subject, were consulted. The KR-20 value of the ASSKT for the main application was calculated to be .79, indicating that the test was also reliable in the main application.

To determine the transfer of students' astronomy knowledge to daily life, the "Transfer of the Astronomy and Space Sciences Knowledge to Daily Life Interview Form (TASSDLIF)" was used. The (TASSDLIF), prepared by the researcher, consists of 13 questions in general. In the formation of the TASSDLIF, the MNE secondary school astronomy and space sciences coursebook, "The Fabric of the Cosmos" book of Greene (2012), and the researcher's course notes were used. Two expert opinions were consulted to create the scientific content of the TASSDLIF and the necessary corrections were made. A pilot study was conducted with 10 students, and at the end of the application, incoherent expressions were corrected, and the main application was started. In the content of the TASSDLIF, the first two questions are about astronomy concepts and the general perceptions for the association of astronomy concepts with daily life, and the other 11 questions are for the association of subtopics in astronomy and space sciences with everyday life (Find all questions attached).

2.4. Data Collection

The main study was carried out in May and June, in the spring semester of 2014-2015. In order to obtain the data in a healthy way, the subjects of "Modern Physics" and "Astronomy and Space Sciences" taught at the university were waited to be finished and then the interviews were started. The interviews lasted for 15-20 minutes for each student and the data were collected with the voice recorder and note-taking method. The notes were transcribed and coded after finishing the voice recording and note taking.

2.5. Data Analysis

The notes obtained with the TASSDLIF were transcribed, and codes and themes were created. The answers of the students were coded and grouped, and the themes of the transfer states were revealed from the codes. The codes were determined to be the wrong answer, only correct answer, correct answer wrong explanation, correct answer

incomplete explanation, and correct answer correct explanation. The themes are in the form of zero transfer, incomplete transfer, and full transfer. The zero transfer is the wrong answer, correct answer no explanation, correct answer wrong explanation; the incomplete transfer is the correct answer incomplete explanation, and the full transfer is the correct answer correct explanation. The codes determined by the two researchers were compared to determine the consistency of the coding. The reliability was calculated to be .88 by using the reliability formula (Reliability= Consensus/Consensus+Dissensus) of Miles and Huberman (1994) for the reliability calculation in the study.

3. Findings

In this section of the study, findings related to the answers to the questions in the aim and sub-aims of the study are included.

3.1. Descriptive Values and Correlation Results Related to the ASSKT and TASSDLIF Scores

Findings obtained from the interview questions are included in this section of the study in which the transfer of Astronomy and Space Sciences knowledge to daily life is investigated. Each question in the TASSDLIF was examined separately.

Table 1: Descriptive Values Related to the ASSKT and TASSDLIF Scores

Tests	N	X	Sd	r
ASSKT	65	11.06	3.57	.28
TASSDLIF	65	1.60	1.33	

According to the analysis results in Table 1, it was concluded that the arithmetic mean of the ASSKT was (X=11.06) and its standard deviation was (Sd=3.57), and the arithmetic mean of the TASSDLIF was (X=1.60) and its standard deviation was (SD=1.33). The correlation between the ASSKT and TASSDLIF was calculated to be ($r_{(65)}$ = .28; $p<.05$) at the $p<.05$ significance level. In this context, it is shown that the correlation between the ASSKT and TASSDLIF is a weak, positive, and significant relationship (Büyüköztürk, 2004).

3.2. Transfer Findings Related to the Explanation Section of the TASSDL

In this section, within the scope of 13 questions in the TASSDLIF, the findings related to the students' general perceptions of astronomy and space sciences (Table 2) and associations of them with daily life (Table 3) were included in the first two questions,

and the findings related to the association of the sub-topics in Astronomy and Space Sciences with daily life were included in the other questions.

Table 2: Students' Perceptions of Astronomy and Space Sciences

Concepts	Frequency (f)	Concepts	Frequency (f)
Sky	30	Moon	9
Stars	28	Astrology	8
Planets	27	Zodiacs	8
Solar system	25	Human creation	7
Galaxy	20	Living and non-living beings	4
Universe	18	Light	4
Galaxies	17	… studies physics, chemistry, and biology	3
Space	17	Physical and chemical change	3
Meteors	16	Everything outside the Earth	3
Stellar Evolution	15	Life Space	2
Meteor	12	Vacuum	2
Constellation	12	Infinity	2
Milky Way	9	Gravitational Field	2

Upon examining Table 2, it has been concluded that the students perceive astronomy and space sciences as sky (f=30), stars (f=28), planets (f=27), and solar system (f=25) at most, and as living space, vacuum, infinity, and gravitational field (f=2) at the least. Furthermore, it can also be said that there are different perceptions of students related to astronomy and space sciences in the other answers given.

Table 3: Opinions related to the Place of Astronomy and Space Sciences in Daily Life

Examples	Frequency (f)	Examples	Frequency (f)
Calendar	29	Earthquake	8
Formation of day and night	27	Lunar and Solar Eclipse	8
Seasons	25	Heating	7
Earth's rotation	22	Fortune-telling	7
Navigation	20	Time	6
Zodiacs	15	Flooding of the Nile	5
Gravity	13	Nuclear material	5
Agricultural activities	12	Beliefs	4
Tide	10	Evolution	3
Astrology	10	Technology	3
Illumination	9	Not relevant	2
Our life source	8		

According to the analysis results in Table 3, the students stated that astronomy and space sciences were generally related to the Calendar (f:29), Formation of Day and

Night (f:27), and Seasons (f:25) in daily life at most, and related to Beliefs (f:4), Evolution process (f:3), and Technology (f:3) at least and two students emphasized that astronomy and space sciences were not associated with daily life. Upon examining other findings, it is remarkable that astronomy and space sciences are associated with fortune-telling, astrology, and beliefs.

Table 4: Opinions Related to the Association of Gravitational Knowledge with Daily Life

Answers	**Relevant to the Subject**		**Frequency (f)**	**Percentage (%)**
Wrong			24	37
Correct	DKWSA		17	26
	KWSA	Wrong Explanation	3	5
		Incomplete Explanation	10	15
		Correct Explanation	11	17
Total			65	100

* DKWSA=does not know with which subject it is associated

* KWSA=know with which subject it is associated

Upon examining Table 4, it was concluded that 24 students (28%) gave the wrong answer and 17 students (26%) gave only the correct answer to the question. Wrong explanations for the correct answers were made by three students (5%), and the explanations for these answers are as follows: *"An object stays on the layer due to gravity. It is similar to the sudden stop of an object (S3),"* and *"The axial tilt of the Earth exists due to gravity. The axial tilt prevents the movement of an object (S63)."* Incomplete explanations for the correct answers were made by 10 students (15%):*"An object comes to the center and stays at the center due to gravity because it is rapidly pulled to the center under the effect of gravity (S8), (S20).", "An object goes down and up due to gravity, but it stays at the center eventually. Gravity affects objects and us everywhere. It is like the falling of a paper after its being sent up in the air and rising (S14), (S43)."* Correct explanations for the correct answers of 11 students (17%) are as follows: *"Since an object accelerates due to gravity, it exhibits a simple harmonic motion toward the center. It is possible to see its examples in springs and pendulums (S7), (S11), (S24), (S25),"* and *"An object goes down and up due to gravity. That is, we can see the presence of gravity in objects falling to the floor, sagging of the skin when aged, and in many more examples between the north and southpoles of the Earth (S54)."*

Table 5*:* Opinions Related to the Association of the Knowledge of the Sphericity of Celestial Bodies with Daily Life

Answers	Relevant to the Subject		Frequency (f)	Percentage (%)
Wrong			39	60
Correct	DKWSA		19	29
	KWSA	Wrong Explanation	1	2
		Incomplete Explanation	1	2
		Correct Explanation	5	7
Total			65	100

According to the results in Table 5, it was determined that 39 students (60%) gave the wrong answer and 19 students (29%) gave only the correct answer to the question. One student made the wrong explanation for the correct answer, and one student made the incomplete explanation for the correct answers. The wrong explanation for this was *"The gravitational force toward the center forms an eddy feature (S13)"*, the incomplete explanation was *"The fact that the central gravitational force affects each point evenly and pulls them toward the center is due to the rotational velocity, elliptical shape, and balancing (S12)."*The correct explanation for the correct answer was made by five students (7%). Some quotations related to the explanations are as follows: *"There is gravitational force toward the center from each point. This force makes you attached to the center, just like a car's coming round the bend or the spherical shape of liquid molecules (S3), (S51).", "There is gravitation toward the center, and if it did not exist or diminished, everything would fall apart. For example, you will not fall while turning a bucket around yourself. (S54)."*

Table 6: Opinions Related to the Association of the Concept of Direction Knowledge with Daily Life

Answers	Relevant to the Subject		Frequency (f)	Percentage (%)
Wrong			7	11
Correct	DKWSA		4	6
	KWSA	Wrong Explanation	2	3
		Incomplete Explanation	9	14
		Correct Explanation	43	66
Total			65	100

As seen from Table 6, it was concluded that seven students (11%) gave a wrong answer to the question and four students (6%) could not explain the association of the astronomy subject with the direction despite giving the correct answer to the problem. The explanations of two students (3%) making wrong explanations for the correct answers are as follows: *"At night, we find our ways from the stars, but there are no stars, but there is only the sun during the day (S23)". "With the help of stars, especially the stars of the*

Milky Way (S38)". Some of the explanations of nine students (14%) making incomplete explanations for the correct answers are as follows: *"It is related to stars at night and the sunrise and sunset during the day, so it is related to stars. This is formed by the lifestyle of first humans. The sea level rise can be an example of this (S12), (S15), (S18).", "During the day, ant nests and tree moss show the north; at night, the pole star shows the north. Mosses vary by the rays of the sun, which is a star and by the current hemisphere (S1), (S21)"*. Some quotations related to the explanations of 43 students (66%) making correct explanations for the correct answers are as follows: *"As a result of the fact that people making caravan trade lost their way while keeping on moving in caravans at night, they observed the pole star constellations, which were always at the same spot, and found out that these stars always showed the north. Thus, the pole stars have been used for the concept of direction since then. During the day, the direction of shadows and the sunrise and sunset was determined (S2), (S25)."*

Table 7: Opinions Related to the Association of the Starburst Knowledge with Daily Life

Answers	**Relevant to the Subject**		**Frequency (f)**	**Percentage (%)**
Wrong			29	45
Correct	DKWSA		17	26
	KWSA	Wrong Explanation	4	6
		Incomplete Explanation	7	11
		Correct Explanation	8	12
Total			65	100

Upon examining the analysis results in Table 7, it is possible to say that the vast majority of the students cannot associate the knowledge of the formation of elements with daily life. In this context, the wrong answers of 29 students (45%) and only the correct answers of 17 students (26%) prove this situation. The wrong explanations for the correct answers of four students (6%) are as follows: *"Elements are made up of stones coming from the starbursts (S21)", "The solar flare consists of parts coming from meteors and other celestial bodies and heat (S54), (S62)."* The incomplete explanations were made by seven (11%) students, and some of these explanations are as follows: *"They are formed by the explosions of stars. They send the elements to us, like the water we use in daily life (S4)", "They are formed by the supernova bursts and the atoms coming together. Atoms form the elements (S18), (S22)"*. The explanations of the eight students (12%) making the correct explanations for the correct answers in the association with the subject are as follows: *"They are made up of some elements (such as helium, carbon, and nitrogen) and substance particles coming from stars as a result of the thermonuclear reaction and explosions in stars. These may also provide for the formation of new elements on the Earth with reactions. They provide for the formation of new living things (S3), (S6), (S24)"*.

Table 8: Opinions Related to the Association of the Conception of the Universe Knowledge with Daily Life

Answers	Relevant to the Subject		Frequency (f)	Percentage (%)
Wrong			52	80
Correct	DKWSA		5	7
	KWSA	Wrong Explanation	3	5
		Incomplete Explanation	2	3
		Correct Explanation	3	5
Total			65	100

Upon examining the results in Table 8, 52 students (80%) gave wrong answers, and five students (7%) gave correct answers. When these two categories were examined, nearly all of the students could not make any explanations for the subject. The explanations of the three students (5%) making wrong explanations for the correct answers are as follows: *"The universe is always balanced, and only the movements of stars change (S58)"* and *"The universe remains the same because I think the energies and gasses change (S51)"*. The explanations of the two students (3%) making incomplete explanations for the correct answers are as follows: *"The universe remains the same, but some things in it change; one thing appears, one thing disappears, one thing fades away, and a new thing occurs because stars or systems have changes in themselves. Everything has responses, such as reactions (S35)"*. The correct explanation for the correct answer was given by three students (5%). The quotation on this subject is as follows: *"Nothing changes in the universe. They change within their own systems. Something happens in the solar system itself. There are a lot of particles like the Earth roaming about. They collide with each other. The orbits change. Because of the orbit, it can pass by a celestial body. And there are many more things, such as in the chemical reaction, the mass is the same at the beginning and at the end, but the resulting element is different (S25), (S38)."*

Table 9: Opinions Related to the Association of the Velocity of the Moon Knowledge with Daily Life

Answers	Relevant to the Subject		Frequency (f)	Percentage (%)
Wrong			38	59
Correct	DKWSA		7	11
	KWSA	Wrong Explanation	3	5
		Incomplete Explanation	13	20
		Correct Explanation	4	6
Total			65	100

According to the analysis results in Table 9, 38 students (59%) gave wrong answers, and seven students (11%) gave correct answers to the effect of the change in the velocity of

the Moon. The expressions of three students (5%) making the wrong explanation for the correct answers are as follows: *"Tides forming on the Earth used to change. The formation of daytime could change and fear used to form in people due to the change in tides (S53)"* and *"Night and daytime periods can change. Because the distance between the Moon and the Earth changes. This can change the formation of daytime and temperature (S2), (S12)".*The incomplete explanations for the correct answers were made by 13 students (20%), and the students' expressions related to this subject are as follows: *"When the distance is the same, the duration of days changes regardless of the velocity. I think the change in the duration of days is caused by the Earth. The changes occurring are just as a car's passing at high speed near us (S19), (S21)".* Some of the expressions of four students (6%) making correct explanations for the correct answers are as follows: *"Since the movement of the Moon changes, its effect on the Earth changes, too. In the rotation of the Moon about its axis, the phases of the Moon change; in its rotation around the Earth, the formation of the day, tides, and movements in the inner structure of the Earth change and this affects magma and earthquakes. Everything depends on the current situation, and we have adapted to it. When they change, life is shaped again (S3), (S20), (S31)".*

Table 10: Opinions Related to the Association of the Telescope Knowledge with Daily Life

Answers	**Relevant to the Subject**		**Frequency (f)**	**Percentage (%)**
Wrong			18	28
Correct	DKWSA		9	14
	KWSA	Wrong Explanation	4	6
		Incomplete Explanation	13	20
		Correct Explanation	21	32
Total			65	100

Upon examining the answers regarding the association of telescopes with daily life, it was concluded that 18 students (28%) gave wrong answers and nine students (14%) were unable to make explanations to their correct answers. Some of the expressions of four students (6%) making wrong explanations for the correct answers are as follows: *"Clear and precise images are obtained in large and mirror systems. The reason for this is that they are made of glass (S8)", "A clearer and more precise image is formed. The fact providing this is that lenses and mirrors in telescopes scatter the light. Thus, the far and near look better (S31)"*. The incomplete explanations for the correct answers made by 13 students (20%) are as follows: *"The fact that lenses and mirrors are large in telescopes enables the light to be gathered and clearer and more precise images to be formed. As the state of gathering the light increases, clarity increases as well. As the power of the telescope increases, the reflected light may decrease, just like the reflection on a smooth surface (S27)."* and *"The diameters of lenses and mirrors should be increased in telescopes to reduce the refraction of the light in the atmosphere.*

Thus, the rays are gathered more. Rays with different wavelengths can be perceived more precisely, like all mirrored systems (S14), (S20)". The correct explanations for the correct answers were made by 21 students (32%). Some of the quotations of the students are as follows: *"Large lenses and mirrors in telescopes are for getting better and more precise information about the universe. Because rays are gathered more and clear and precise images are obtained with large optical systems. Just like professional photography machines, they are perfect for clear and detailed images (S10), (S12)."*

Table 11: Opinions Related to the Association of the Stellar Evolution Knowledge with Daily Life

Answers	**Relevant to the Subject**		**Frequency (f)**	**Percentage (%)**
Wrong			48	74
Correct	DKWSA		5	8
	KWSA	Wrong Explanation	4	6
		Incomplete Explanation	4	6
		Correct Explanation	4	6
Total			65	100

Upon examining Table 11, it was concluded that 48 students (74%) gave wrong answers, and five students (8%) gave correct answers to the question but could not make any explanation. From here, it is understood that the stellar evolution knowledge is not associated with daily life. Some of the explanations of four students (6%) giving correct answers but making a wrong explanation in the association with daily life are as follows: *"The stars are born and die like people. Stars contribute to many aspects of living and non-living things, for example, superstitious beliefs and astrology. For example, it is believed that a living thing dies when there is a shooting star (S55)".* Explanations such as *"Stars contain elements and minerals. We are also made up of elements. As stars age and die, these are scattered around and reach the Earth. They provide element resources for us (S28), (S56)"* were taken to the category of incomplete explanations for correct answers and were expressed by four students (6%). Explanations such as *"If at first, there is a mass with a thermonuclear reaction, 4 hydrogen turns into helium. If helium is burned in the star center, carbon occurs; if carbon is burned, oxygen occurs, then, nitrogen, and finally, iron occurs. Iron has a stable nucleus. No outward explosion occurs inside the star. It stops and subsides inwards. This reaction brings the next elements after iron. If there is a planet around the star, the formation of a living thing can occur, and microorganisms are formed around here. Just like all living mechanisms, everything passes through different processes during birth and death (S25), (S43)"* were taken to the category of incomplete explanations for correct answers and were expressed by four students (6%).

Table 12: Opinions Related to the Association of the Star Distances Knowledge with Daily Life

Answers	Relevant to the Subject		Frequency (f)	Percentage (%)
Wrong			45	69
Correct	DKWSA		11	17
	KWSA	Wrong Explanation	4	6
		Incomplete Explanation	3	5
		Correct Explanation	2	3
Total			65	100

Upon examining the analysis results in Table 12, the fact that 45 students (69%) gave wrong answers, 11 students (17%) gave only correct answers, and four students (6%) gave wrong explanations for correct answers shows that the knowledge of star distances is not associated with daily life. In this context, some of the wrong explanations for correct answers are as follows: *"Stars are far from us and affect the shape of the Earth, and this make the Earth constantly illuminated (S34)"*, *"The fact that stars are far away affects the illumination of the Earth. The biggest factor is the sun, the biggest star. At the same time, it is the interaction of the sun with the Earth (S37)"*. The incomplete explanations for correct answers were given by three students (5%), and their expressions on this subject are as follows: *"The Earth is always warm and illuminated. The stars warm and illuminate us both during the day and at night. It does not mean that they do not exist when it is night and they are not observed, they are just too far away. Although they are far away, they contribute to our world from every aspect. Distances only change the effect of temperature on us in some cases (S39), (S51)"*. Scientific correct explanations for correct answers were given by two students (3%), and the corresponding explanation is as follows: *"The sun and many stars that are far away that we cannot see them warm us up day and night. Some of the stars are far away and have not even been discovered yet, but we feel their effects. This is felt as heat and temperature, and we can observe it with telescopes. Stars' being far away does not mean they do not exist, but we only feel their effects more or less, just like heaters. The much more electromagnetic wave comes from the close ones, and we warm more. Fewer waves come from the distant ones, and we warm less, and they affect us less. That is the way in the stars (S23), (S54)"*.

Table 13: Opinions Related to the Association of the Knowledge of the Alignment of Planets in the Solar System with Daily Life

Answers	Relevant to the Subject		Frequency (f)	Percentage (%)
Wrong			56	85
Correct	DKWSA		1	2
	KWSA	Wrong Explanation	3	5
		Incomplete Explanation	2	3
		Correct Explanation	3	5
Total			65	100

In Table 13, it was concluded that 56 students (85%) gave wrong answers and one student (2%) gave the correct answer to the question. However, some of the wrong explanations for correct answers of the three students (5%) are as follows: *"The alignment of the planets in the solar system arises from their densities and factors affecting this density are the atmosphere and underground resources (S3)"*. The incomplete explanations for correct answers were made by two students (3%), and the related explanations are as follows: *"... the formation of the planets in this way depends on the density of the planets. So, everything that affects the density also affects this situation. For example, one of them is the mass. The mass exists in every object and its effect can be found by using density formulae (S55)"*. Scientific correct explanations for correct answers in the table were expressed by three students (5%). Some of the quotations from these explanations are as follows: *"Planets are formed according to the density of the planets in the solar system. There are many factors affecting the density such as the mass, volume, temperature, gasses in the precipitation, etc. For example, in daily life, we can explain the type of objects by the density and the floating of objects by the density, too. We can explain the alignment of the planets accordingly. For example, temperature and density are generally inversely proportional, and density varies by objects, which changes the molecular bonds (S10), (S19)"*.

Table 14: Opinions Related to the Association of the Earth's Crust Knowledge with Daily Life

Answers	Relevant to the Subject		Frequency (f)	Percentage (%)
Wrong			50	77
Correct	DKWSA		7	11
	KWSA	Wrong Explanation	4	6
		Incomplete Explanation	4	6
		Correct Explanation	0	0
Total			65	100

According to the analysis results in Table 14, 50 students (77%) gave wrong answers, and seven students (11%) gave only correct answers to the question. Wrong explanations for correct answers to the question were given by four students (6%), and the relevant explanations are as follows: *"The Earth's crust allows for the creation of living things. It is the gasses and the atmosphere formed by the Earth's crust that provides this (S39)."*The incomplete explanations for correct answers were given by four students (6%) as follows: *"It enables the inside of the Earth to be in a liquid state. Why? Because the Earth is a living planet. In other words, there is liquid iron at the temperature of 4000^{o}C at its core. This hot liquid iron provides us with the atmosphere, oxygen, gravity, and magnetic field. When this circular core, which is in the form of a hot liquid iron, becomes cold, then the death will be inevitable for people and other living things (S45), (S61)"*

Table 15: Values Related to the Answers Given to the TASSDL

	Answers (Frequency)					
	Wrong	**Correct**	**Correct Answer and Association**			
Subjects			**Wrong Explanation**	**Incomplete Explanation**	**Correct Explanation**	**Total**
1.Gravity	24	17	3	10	11	65
2. Celestial Bodies	39	19	1	1	5	65
3.Navigation	7	4	2	9	43	65
4.Starburst	29	17	4	7	8	65
5.Reaction of the Universe	52	5	3	2	3	65
6.Velocity of the Moon	38	7	3	13	4	65
7.Telescope	18	9	4	13	21	65
8.Evolution of the Stars	48	5	4	4	4	65
9.Star Distances	45	11	4	3	2	65
10.Planets	56	1	3	2	3	65
11. Earth's Crust	50	7	4	4	0	65
Total	406	102	35	68	104	715
Answer (%)	56.7	14.3	4.9	9.5	14.5	100

Upon examining Table 15, it was concluded that 56.7% of the total answers given to 11 questions were wrong answers, 14.3% were only correct answers, 4.9% were wrong explanations for correct answers, 9.5% were incomplete explanations for correct answers, and 14.5% were correct explanations for correct answers. Upon examining the association of the astronomy and space sciences knowledge with daily life on the basis of questions, it was determined that the state of the most association was in the subjects of "Direction, Telescope, and Gravity", the state of the least association was in the subject of "Earth's Crust, Planets, Reaction of the Universe, Star Distances". In other subjects, it is possible to say that the association with daily life is close to each other.

4. Discussion and Conclusion

4.1. Discussion of the Relationship between the ASSKT and TASSDL

In the study, the students' astronomy and space sciences knowledge and their relation with the ASSKT and TASSDLand transfer levels were examined. As a result of the findings obtained, it was determined that there was a weak, positive and significant correlation between the two tests ($r_{(65)} = .28$; $p<.05$). In this context, it can be said that students could not associate the astronomy and space sciences knowledge with daily

life and therefore could not transfer it. This is supported by the fact that the zero transfer level (76%) obtained with the TASSDL was high, and the full transfer level (14.5%) was low. There are no studies parallel to the low correlation level of the astronomy and space sciences knowledge obtained as a result of the study in the related literature and its association with daily life. However, in the study of Durukan and Arslan (2013), the low correlation obtained by associating the basic astronomical concepts with each other is parallel to the research result. Furthermore, upon examining the research result within the scope of physical sciences related to astronomy and space sciences, it has parallels with the studies of Yeşildağ, 2009 in physics subjects; with the studies of Özmen (2003) in chemistry subjects.

4.2. Discussion of the TASSDLF Transfer Levels

Within the scope of the first two questions in the TASSDLF, students were asked about their perceptions of astronomy and space sciences and its association with daily life in general. According to the results obtained, while students defined astronomy and space sciences mostly as Sky, Planets, Stars, Solar System, Galaxy, Conception of the Universe, and Galaxy, they defined everything else outside the Earth with expressions not relevant with astronomy such as Astrology, Zodiacs, and Vacuum. From here, it is possible to say that students have misconceptions within the scope of astronomy and space sciences. In other studies conducted with preservice teachers (İyibil & Sağlam Arslan, 2010; Trumper, 2003; Trumper, 2001; Kalkan & Kıroğlu, 2007; Küçüközer, 2007), it was determined that there were also misconceptions about astronomy space sciences.

In the study, the association of astronomy and space sciences with daily life was asked to students in general and while the students emphasized that astronomy and space sciences were mostly associated with the calendar, day formation, seasons, movement of the Earth, and navigation, they also gave answers such as tide, agricultural activities, and earthquakes. However, it was found out that they also had thoughts such as astrology and fortune-telling that were not related to astronomy and space sciences. In the relevant literature, the studies of Trumper (2000), Trumper (2001), Bakas & Mikropoulos (2003), İyibil & Sağlam Arslan (2010) have parallels with the research result in which students associated the astronomy and space sciences knowledge mostly with the daylight formation, tides, season formation, navigation, and astrology.

The reason for the low level of transfer in the association of the astronomy and space sciences knowledge with daily life is understood from the student's answers that there is a lack of knowledge in astronomy and space sciences, the continuation of using ordinary daily knowledge instead of scientific knowledge, and the thought of the necessity of learning astronomy knowledge only theoretically. Furthermore, upon

examining the transfer levels according to the subjects, it was concluded that the zero transfer level was in the subjects of "Earth's Crust, Star Distances, and Reaction of the Universe", and the full transfer level was in the subjects of "Navigation, Telescope, and Gravity" at most. The reason for the fact that the full transfer level is higher in these subjects may be due to the fact that these subjects are mentioned more in daily life, these subjects are included more in the disciplines of physical sciences in primary and secondary school education, daily life examples given in relation to astronomy during lessons are concentrated more in these subjects, and scientific studies conducted are mostly on these subjects. In this context, Ünsal, Güneş & Ergin (2001) state in their study that students frequently encounter the Earth and gravity, the sun and its features, the Moon and its features in daily life and this makes learning easier. Moreover, the statement that learning the Earth and the factors affecting the Earth, subjects of navigation, gravity, and celestial bodies (especially, the Moon) should be prioritized in studies and the increase in the number of studies in this direction affect the learning in students (İyibil, 2010).

The reason why the zero transfer level is high in the subjects of "Earth's Crust, Star Distances, and the Conception of the Universe" and the answer rates are close to each other can be explained by the answers given by the students that they only describe the sun as the star at star distances and their thinking that stars are in a very small size instead of understanding that they are far away. However, the fact that the Earth's crust is regarded as only a piece of land by the students and the students' expressions that there is only the distancing of celestial objects in the conception of the universe show that the students' knowledge on this subject is inadequate. The results obtained with the Star distances and the Conception of the Universe in the study is in parallel with the studies of Keçeci (2012) and Taşcan (2013). The fact that the students' knowledge status in these subjects is at the zero transfer level is also due to the lack of top-level skills such as three-dimensional thinking and the use of imagination (Güneş, 2010). Kurnaz and Değirmenci (2011) and Keçeci (2012) emphasize that explaining the astronomy concepts based on the concepts learned in the past leads to incomplete learning.

Although the incomplete and full transfer levels are at the same level in the findings related to the association of the starburst knowledge with daily life, the zero transfer level is higher. The reason for the high level of the zero transfer of students can be understood from the student's answers that the stars are only related to the sun and that starbursts provide only heat and temperature. However, along with providing heat and temperature, the stars turn hydrogen into helium, helium into carbon, carbon and helium nucleus into oxygen and many elements with nuclear fusion reactions and they are the sources of the elements on the Earth and provide the formation of the periodic

table (Burnie, 2000). However, at educational levels, the periodic table is taught by learning it by heart in the disciplines of chemistry, physics, biology, and other physical sciences. This situation causes the information to be perceived as being independent of each discipline and to be learned separately from daily life (İyibil & Sağlam Arslan, 2010).

The transfer level of the subject of the evolution of stars to daily life is the same as that of star distances, and the result that the zero transfer level was too high and the full transfer was low was obtained. This shows that the students have incomplete knowledge of the stars and cannot transfer their knowledge. Student answers show that they only perceive stars as the sun and students' specifying the stars as heat/temperature sources show that their knowledge is limited. This result is in parallel with the studies of (İyibil & Sağlam Arslan, 2010; Durukan & Sağlam Arslan, 2013).

Upon examining the transfer levels of the knowledge of celestial bodies and the change in the velocity of the Moon, it was concluded that the full transfer levels were close to each other and that the incomplete transfer level was higher in the subject of the velocity of the Moon. The fact that the students specified celestial bodies only as a magnitude order in the solar system indicates that learning by heart is still continuing. It is understood from the students' answers, in which knowledge is structured in a limited area, that the velocity change that occurs in the Moon is only associated with the formulaic Keppler's Law and tides. Shen & Confrey (2008) point out that the problems in the association of celestial bodies with daily life are caused by the fact that students concentrate more on gravitational laws, planets and their basic features in terms of the celestial bodies from the primary school to this grade.

The reason for the high full transfer level in the subject of the telescope is to ensure the interdisciplinary association of the knowledge of the association of telescopes with lenticular systems, such as camera, binoculars, microscope, etc. It also supports the end result that students are very dominant about the subject of optics.

As a result, upon examining the values related to the TASSDL, it has been shown that students have difficulty in associating the astronomy and space sciences knowledge with daily life. Upon examining the reasons for this, it is remarkable that students try to answer the questions with non-scientific knowledge they obtain in daily life, that knowledge is not completely scientifically structured in the course of astronomy and space sciences, that instead of associating the knowledge with the course of astronomy and space sciences, students try to associate the knowledge with independent knowledge during the question answering process, and that the incomplete or wrong knowledge obtained in the primary and secondary school still continues. Furthermore, the facts that the subjects of astronomy and space sciences have just started to gain their place at universities, students are not provided with the

problem-solving process, students find the subjects of astronomy and space sciences abstract, and their attitudes stating that the astronomy course is difficult continue can be listed as the problems arising from the lack of material and time during teaching.

The research results have shown that the transfer status of the students' knowledge of astronomy and space sciences to daily life is close to the zero transfer level. For this reason, it can be recommended to teach the course of astronomy and space sciences at schools in a more concrete and understandable way. Moreover, researchers can be recommended to carry out similar studies at different levels of education, at different grade levels and with different subject content.

References

1. Bakas, C., & Mikropoulos, T. (2003). Design of virtual environments for the comprehension of planetary phenomena based on students' ideas. *International Journal of Science Education*, 25 (8), 949–967.
2. Balkan, F.K. (2008). *Fen Bilgisi öğretmen adaylarının günlük yaşamları ile bilimsel bilgileri ilişkilendirebilme düzeyleri ve bunu etkileyen faktörler. Doktora tezi, Gazi Üniversitesi, Ankara.*
3. Bekiroğlu, F.O. (2007). Effects of model-based teaching on pre-service physics teachers' conceptions of the moon, moon phases and other lunar phenomena. *International Journal of Science Education*, 29(5), 555-593.
4. Büyüköztürk, Ş. (2004). *Verianalizi el kitabı*(4.Baskı). Ankara: Pegem A Yayıncılık
5. Cin, M. (2007). Alternative views of the solar systems among Turkish students. *International Review of Education*, 53(1), 39-53.
6. Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches.* Sagepublication
7. Durukan, Ü. G. ve Sağlam Arslan, A. (2013). Fen bilgisi öğretmen adaylarının temel astronomi kavramlarını ilişkilendirme durumlarının analizi. *Fen Eğitimi ve Araştırmaları Derneği Fen Bilimleri Öğretimi Dergisi*, 1(2), 97-109.
8. Düşkün, İ. (2011). *Güneş-Dünya-Ay modeli geliştirilmesi ve fen bilgisi öğretmen adaylarının astronomi eğitimindeki akademik başarılarına etkisi.*Yüksek lisans tezi, İnönü Üniversitesi, Malatya.
9. Etkina, E., Karelina, A., Villasenor, M. R. (2006, August), *Studying transfer of scientific reasoning abilities,* Paper presented at the meeting of the AAPT National Meeting, Salt Lake City, UT.

10. Fortus, D., Krajcik, J., Dershimer, R. C., Marx, R. W., & Mamlok-Naaman, R. (2005). Design-based science and real-world problem-solving. *International Journal of Science Education,* 27, 855-879.
11. Güneş, G. (2010). *Öğretmen adaylarının temel astronomi konularında bilgi seviyeleri ile bilimin doğası ve astronomi öz-yeterlilikleri arasındaki ilişkinin incelenmesi*. Yükseklisanstezi, Çukurova Üniversitesi, Adana.
12. İyibil, Ü. (2010). *Farklı programlarda öğrenim gören öğretmen adaylarının temel astronomi kavramlarını anlama düzeylerinin ve ilgilik avramlara ait zihinsel modellerinin analizi*. Yüksek lisans tezi, Karadeniz Teknik Üniversitesi, Trabzon.
13. İyibil, Ü. ve Arslan Sağlam, A. (2010). Fizik öğretmen adaylarının yıldız kavramına dair zihinse lmodelleri. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi*, 4, 2, 25-46.
14. Kalkan, H., & Kıroğlu, K. (2007). Science and non-science students' ideas about basic astronomy concepts in pre-service training for elementary school teachers. *Astronomy Education Review,* 6(1), 15-24.
15. Kalkan, H. Ustabaş, R. ve Kalkan, S. (2007). İlk ve ortaöğretim öğretmen adaylarının temel astronomi konuları hakkındaki kavram yanılgıları. *Ondokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi*, 23, 1–11.
16. Keçeci, T. (2012, 26-28 Nisan). *İlköğretim öğrencilerinin astronomiyle ilgili temel kavramları anlama düzeyi ve astronomi dersinin eğitim için önemi*. 3. Uluslararası Eğitimde Yeni Yaklaşımlarve Etkileri Konferansındasunuldu, Antalya.
17. Kılıç, E., Karadeniz, Ş. Ve Karataş, S. (2003). İnternet Destekli Yapıcı Öğrenme Ortamları. *Gazi Üniversitesi Eğitim Fakültesi Dergisi.* 23(2). 149-160.
18. Kikas, E. (2004). Teachers' conceptions and misconceptions concerning three natural phenomena. *Journal of Research in Science Teaching,* 41(5), 432- 448.
19. Kurnaz, M. Ve Değermenci, A. (2011). Temel astronomi kavramlarına ilişkin algılamalarının sınıf seviyelerine gore karşılaştırılması. *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi,* 11(22), 91-112.
20. Küçüközer, H. (2007). Prospective science teachers' conceptions about astronomical subjects. *Science Education International,* 18(2), 113-130.
21. Lee, H. S., & Lıu, O. L. (2009), Assessing learning progression of energy concepts across school grades: the knowledge integration perspective. *Science Education*, 94, 665-688.
22. McKeachie, W. J. (1987), Can evaluating instruction improve teaching? *New Directions for Teaching and Learning,* 31, 3-7
23. MNE, (2009). *Ortaöğretim fizik öğretim programı*. Ankara: Talim ve Terbiye Kurulu Başkanlığı.

24. MNE, (2010). *Ortaöğretim astronomi ve uzay bilimleri dersi öğretim* programı. Ankara: Talim ve Terbiye Kurulu Başkanlığı.
25. H. (2003). Chemistry student teachers' levels of linking their knowledge with daily life about acid and base concept. *Kastamonu University Journal of Educational Facuty,* 11(2), 317-324.
26. Panagiotaki, G., Nobes, G. & Potton, A. (2009). Mental models and other misconceptions in children's understanding of the Earth. *Journal of Experimental Child Psychology,* 104(1), 52- 67.
27. Shen, J., & Confrey, J. (2008). Justifying alternative models in learning astronomy: A study of K-8 science teachers' understanding of frames of reference. *International Journal of Science Educatio*n, 32(1), 1- 29.
28. Taşcan, M. (2013). *Determine of science teacher's knowledge level about basic astronomy subjects (The example of Malatya.)* Master's thesis, Inönü University, Malatya, Turkey.
29. Trumper, R. (2000). University Students' Conceptions of Basic Astronomy Concepts. *Physics Educat*ion, 35 (1), 9-15.
30. Trumpher, R. (2001). A Cross-Age study of junior high school students' conceptions of basic astronomy concepts. *International Journal of Science Education,*23 (11), 1111-1123.
31. Trumper, R. (2003). The Need for change in elementary school teacher training—a cross-college age study of future teachers' conceptions of basic astronomy concepts. Teaching and Teacher Education, 19, 309–323.
32. Trundle, K. C., Atwood, R. K., & Christopher, J. E. (2002). Preservice elementary teachers' conceptions of moon phases before and after instruction. *Journal of Research in Science Teaching,* 39(7), 633-658.
33. Unat, Y. (2001) *Türk Astronomi Tarihi Literatürü*, 1. Baskı, Ankara: Nobel Yayın Dağıtım
34. Ünsal, Y., Güneş, B. ve Ergin, İ. (2001). Yüksek öğretim öğrencilerinin temel astronomi konularındaki bilgi düzeylerinin tespitine yönelik bir araştırma, *Gazi Eğitim Fakültesi Dergisi*, 21 (3), 47-60.
35. Vermette, P. & Foote, C. (2001). Constructivist philosophy and cooperative learning practice: toward ıntegration and reconciliation in secondary classrooms. *American Secondary Education.* 30(1). 26-37.

Appendix 1

Questions

1. What does astronomy and space sciences mean to you?
2. What do you think about the place of astronomy and space sciences in your daily life?
3. What changes do you observe in the movement of an object when a hole is made from the north pole of the Earth to the South Pole, and the object is thrown from the North Pole? Why?
4. What can be the reason for the fact that all celestial bodies and planets have a spherical structure? What can be examples from daily life?
5. How do you find your way at night and during daytime? Why?
6. All the elements used in daily life are in the periodic table. What do you think is the source of all these elements? Why?
7. How does the universe, which contains many galaxies, celestial bodies, and many celestial events (meteor fragmentation, star death, etc.) react? Why?
8. If the velocity of the Moon was less or more than its current velocity, would there be any changes in terms of the Earth? Why?
9. What do you think about very large sizes of the lenses and mirrors used in the Hubble space telescope together with the developing technology?
   - Are there devices suitable for this situation in daily life?
   - Why?
10. The living and non-living things in the world have many contributions to the soil, the earth surface, etc. What do you think about the contribution of the birth, growth, and death (evolution) of the stars to the living and non-living things on the Earth? Why?
11. What do you think about the constantly warm and illuminated state of the Earth although there are too many stars in the universe? Why?
12. What do you think about the way the planets are aligned in the solar system? How do you associate it with daily life? Why?
13. What do you think about the contribution of the Earth's Crust to living things?