A summer camp experience of primary student: Let's learn astronomy, explore the space summer camp

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Contents

Abstract

It is important to structure children's knowledge and arouse their interest in subjects like astronomy and space. Although we now talk of travelling to the moon, space tourism etc., knowledge about astronomy and space is limited and perceptions of these subjects do not reflect scientific reality. Primary level students often have misconceptions about nature and the universe. This study aims at raising the participating students' awareness of the concepts and themes of astronomy and space

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and identifying whether they are able to use the knowledge they acquire in this process in their daily lives. The participants are applied a pretest and a post-test in the form of comprehension questions about astronomy and space. Parallel to that, a semi-structured interview and Scientific Knowledge Scale was applied before and after the science camp. Moreover, at the end of the camp the students were asked to write compositions and to draw pictures for observing their skills about expressing astronomy in both written and visual data. The results are also supported by quantitative data. The obtained qualitative and quantitative data was analyzed. By the end of the activity based program, the participant students effortlessly learned about astronomy and space, and their interest on the topic increased. If enhancing students' concepts about astronomy with enjoyable instruction without exam worries is considered an important issue for teachers and other educators, science camps can be suggested to enhance other relevant and irrelevant science concepts as well.

Keywords: Astronomy, Space, Sky, Observation, Science Camp, Primary School Students.

Introduction

Students approach science lessons with their own ideas about the natural world. These ideas, though logical to the students at times, are not scientific most of the time. These kinds of ideas can be named as alternative concepts, misconceptions, and children's fixed ideas about science (Yair, 2001). It is known that students have many misconceptions about science (Pfundt & Duit, 1998). Astronomy is one of the main subjects in which students have misconceptions. Nowadays, although have started to talk about voyages to the moon, space tourism, etc., it has been observed that actual knowledge about astronomy and space is quite limited. Moreover, students' perceptions of these subjects do not reflect scientific reality. In primary school education where students begin to learn about nature and the universe, students have misconceptions about the Earth, our home in the universe. Some primary school students' express that the Earth is flat, square or rectangular. Furthermore, children who know that the world is a sphere believe that there is a geographic end of the Earth and if we reach it, we may fall off. The reason behind these beliefs may be the inappropriate expressions used when talking about the world in our daily lives. It is generally said the Earth is round, they assume it to be round like a flat tray (Vosniadou, Skopeliti, & Ikospentaki, 2005). Some other students think that at the end of the day and the night while the moon and sun replace each

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other, the other one goes underground. Although students state that the Earth is a sphere they believe that living on the edges of the world is impossible. They imagine that the people living on the lower part could not stand up, otherwise they would fall off (Vosniadou, 1991; Vosniadou & Brewer, 1994; Vosniadou, Skopeliti, & Ikospentaki, 2004). Similarly, the following misconceptions are often seen; *all stars are white, the moon doesn't revolve on its axis as we only see the same side, the moon disappears during the day, the phases of the moon are a result of the Earth's shadow, Mars is a hot planet because of its color, the sun is not actually a star, a light-year is actually a time slice* (Lunar and Planetary Institute 2006).

Although the subject of astronomy is more interesting than other the science subjects for primary school students (Dede, 1995; Winn, 1995), students often have difficulty in understanding complex astronomical concepts. Three dimensional and dynamic concepts such as day/night cycles, seasons, eclipses, phases of the moon, and movements of planets can be given as examples. Moreover, as astronomy subjects include numerous detailed and abstract concepts, they are difficult subjects for students to understand (Yair, Schur & Mintz, 2003; Dunlop, 2000). Although teaching astronomy is a main component of science education, students who have difficulty in learning abstract astronomical concepts make teaching astronomy difficult (Dunlop, 2000).

When the literature is reviewed, it is seen that there are studies to overcome these misconceptions (Korkmaz, 2009; Aktamış & Ünal Çoban, 2009; Taylor, Barker, & Jones, 2003; Alkış, 2006). Furthermore, studies conducted by Emrahoğlu & Öztürk (2009), Frede (2008), Trumper, (2006), Fong, Percy, & Woodrruff (2004), Barab et al. (2000) and Ünsal et al. (2000) stated that some teachers and candidate teachers also have misconceptions and a lack of knowledge in astronomical concepts. The students should structure their knowledge in subjects about nature, the universe, astronomy and space. In addition to that, it is important that their interest in these subjects be encouraged as well. When primary education curricula are examined, it is generally seen that astronomy subjects are placed at the end of the instructional flow and addressed at the end of the instructional term. Additionally, some teachers are not at the required cognitive and affective level for teaching astronomy in terms of knowledge base, attitudes and motivation towards teaching astronomy, resulting in insufficient importance being applied to the teaching of astronomy.

In the nature of science education, students need to be able to observe what is going on around them. Students should be able to interpret their surroundings in their

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minds and apply this knowledge to new events and situations. In this regard the role of a teacher is to provide materials that arouse interest and encourage learning. However, the prevailing idea in the education system is; learning occurs by transferring exactly the same knowledge from source to the student. Science has been affected by this teaching method and teaching science based on knowledge transfer, and perceiving students as passive receivers has become widespread. Teachers cannot avoid the idea that the more knowledge transferred to the students, the more they learn, and as a result what is learned can only reach the short term memory and therefore meaningful learning doesn't take place (Chen et al., 2007). The teaching method embraced by most teachers and based on the above understanding includes only images, pictures and two dimensional animations. It is thought that this approach inhibits the effective teaching of astronomy in classes. In traditional methods, teachers do not sufficiently guide students in understanding difficult and complex astronomy concepts. In addition to that teachers have difficulty in teaching certain concepts. So students have incorrect knowledge and ideas about astronomy and astronomy concepts (Winn, 1995; Ojala, 1997).

One of the common misunderstandings, that the Earth we live in is not a part of the Universe, can be overcome through science camps where they can enjoy playing and learning without worrying about things such as exams.. These camps are known to be very effective on structuring astronomy subjects among students. According to the National Research Council (NRC) (1998) teaching science outside of formal teaching activities may be an effective method for making use of students' spare time in order to improve their affective learning fields as well as their social and cognitive ones. Science camps, be seen as a form of these informal learning areas, create opportunities for children and adults to share their interests and emphasizes the richness and creativity by enabling them to choose role models in science related occupations. Our aim with "Let's Learn Astronomy, Explore the Space Summer Science Camp" (LLAESSC) is creating awareness about Astronomy and Space in daily life and increasing scientific literacy levels related to primary education program activities among students. Students from the Social Services and Child Protection Institute (SSCPI) and Boarding Primary District Schools (RPBS) participated in the science camp. By participating in the camp, students from Social Services and Child Protection Institute (SSCPI) and Regional Primary Boarding Schools (RPBS) experienced scientific activities about basic astronomy subjects related to the Earth and Universe apart from their school. It is expected that they implicitly gained awareness about scientific information. Therefore, this study

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attempts to present the effects of astronomy science camp on students' comprehension of astronomy and their ideas about scientific information.

Problems:

1. Do LLAESSC make a difference in the SSCPI and RPBS participants' ideas regarding scientific knowledge when compare to their ideas before the camp?
2. Do LLAESSC make a difference in the SSCPI and RPBS participants understanding of concepts about the Earth and Universe when compare to their achievement before the camp?
3. How do SSCPI and RPBS participants of LLAESSC express their ideas about the Earth and Universe in their drawings and written compositions?

Methodology

Statement of the problem

The study was conducted at the summer science camp where theoretical and practical knowledge intertwined; knowledge was reinforced with activities like conducted experiments, observations and games. As the study generally observed a process, the participants' activities were observed and individual works were evaluated, a qualitative design was followed.

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Participants

The primary school students participating in the summer science camp are composed of students from SSCPI and RPBS. SSCPI is a place for children who lack or are abandoned by their family. RPBS is a boarding school established for both the education and housing of children living in remote areas, who would otherwise be unable to attend school due to transportation issues. The study is conducted as a summer science camp whose target group - in the broad sense - is composed of 6th, 7th, and 8th (11-14 year olds) grade primary school students. A

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total of 36 students, 19 of whom were from RPBS and 17 of whom were from SSCPI attended the summer camp. The selection of students is on the based on the willingness of the students. The required authorizations were obtained from either their parents or the organizations.

Introduction to "The Lets Learn Astronomy Explore Space Summer Science Camp"

LLAESSC was held over the course of two five day terms. The SSCPI students participated in the first term and the RPBS students' participated in the second term. The camp staff that helped carry out the activities were composed of one astronomer, one astronomy historian, one physicist, two scientists and one academician being master of elementary education. Additionally, six undergraduate science students interested in astronomy assisted the camp during the activities. The aim was for the participants to learn while having fun, being involved in activities such as forming questions (videos watched about astronomy), making space observations (observing space with a telescope), building and using astronomical equipment (building a telescope and creating experiments to understand the formation of seasons), collecting data during activities (i.e. drawing what they saw during space observation), commenting on produced works (commenting on drawings). After providing training about the Earth and Universe with some courses, demonstrations, observations and experiments, it was requested that the participant students draw and write about they learned. These drawings and writings were the tools reflecting the perceptions and interpretations of the participants. The students conducted their various activities such as writing compositions, drawing pictures and conducting experiments sitting four or five to a table. Moreover, we aimed to create a friendly atmosphere that included socialization during this process. Camp staff and participants spent time together outside of the activity schedules doing things such as having meals together, going on walks, playing games, etc.

Data Collection Instruments:

Data was collected through various tools which are described in short below. In addition to these tools, tasks performed by the students (compositions and drawings) at the end of the camp were examined.

Earth and Universe Achievement Questions (EUAQ)

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In order to measure the participants' content knowledge level in astronomy and space subjects identified within the project, test questions for EUAQ were prepared. There were 40 questions about the subjects in science camp. This test measures students' subject content knowledge. It was administered to 100 students for reliability and validity statistics. Instrument reliability was calculated through the ISTA package program and the KR-20 reliability coefficient was found to be .93. Some sample items from the EUAQ are provided in Table1.

Table 1. Sample Items from the EUAQ

3. Which of the following statements about the shape of the world is an example of the wrong thoughts in ancient times?
A) The world resemble a triangle B) All layers of the world can be observed C) The world has layers D) The world is flat, and if it is turned over the ships at sea may fall from the edge
6. Which of the following statements is a result of rotation around the world's axis?
A) the formation of seasons B) the formation of caves C) the formation of day and night D) to the formation of a year

Scientific Knowledge Scale (SKS)

The purpose of the Scientific Knowledge Scale is to determine primary school students' views about scientific knowledge. The Scientific Knowledge Scale was administered before and after the camp in order to follow the development in students' opinions for science and scientific studies (such as raising awareness among students toward scientific studies about astronomy, how scientific knowledge is constructed, under which circumstances it was formed, how scientists worked). The Scientific Knowledge Scale developed by Ünal Çoban & Ergin (2008) is composed of 16 items and 3 factors. It is a 5-point Likert-type scale and the highest and lowest score that can be achieved from the scale is 80 and 16 respectively. The scale is composed of 8 positive and 8 negative items. The structure of the instrument used in the science camp is composed of three factors; *scientific knowledge is indisputable* (8 items), *scientific knowledge may change* (3 items), and *scientific knowledge is justified* (5 items). Cronbach alpha reliability coefficient for whole instrument was found .83.

Table 2. Sample Factors and Items from *Scientific Knowledge Scale*

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Factors	**Sample items**
Scientific knowledge is indisputable?	Scientific knowledge is always true.
Scientific knowledge may change	Scientific ideas change over time.
Scientific knowledge is justified	Before beginning an experiment, it is good to have an idea about it.

Interview Questions about Earth and Universe (IQEU)

Interview questions were prepared parallel to the EUCQ and the misconceptions identified at the end of the reviewed literature about the subjects given in the camp. Prepared questions were given to three academicians and three teachers, expert in their fields, for their opinion. Moreover, pilot interviews were conducted with primary school students in order to ensure validity.

Activities in LLAESSC:

The LLAESSCs were comprised of various enjoyable activities related to astronomy and space. First, all the staff and participants attended an introduction activity for adapting the LLAESSC participants to the camp. "Expressing a request", "Being creative", "Learning to trust" activities were conducted to increase participants' socialization and adaptation skills. In addition, "Does the sky move?" "Making up a story" games were played during this session. Participants and staff played sports and swam as spare time activities. In this manner, it was ensured that participants and staff interacted and were able to communicate more easily.

After the introduction session, the students partook in an activity to understand movements of the Earth "Reason for seasons and day/night cycles" and watched an animation about the subject. In order to attract participants' interest in the sky, a "Let's make our own galileoscope" activity was carried out. The "Let's observe star clusters" activity was aimed to observe the night sky via telescope every night, and consequently raise awareness about how the Earth moves, and reinforce that objects in the sky do not always settle in the same . The participants were given a reading text about the *development of sky observation in history* and asked to read it in another activity. Then, participants were asked to form groups and create plays about "Galileo's life". Participants watched a film about how rockets were sent to space and they had an experiment to understand how rockets travel in space. After that participants built a rocket in their study groups and tried to launch it. In addition to these activities, the participants had an activity about how the first sundial was made. At the end of the camp, the participants were asked to write a composition and draw

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a picture to express what they learned during the camp. Small competitions were held to increase motivation among participants and make the activities more enjoyable. The participants who wrote the best composition and drew the best picture were given a small telescope. By doing so it was aimed to preserve the interest of participants in both summer science camps and astronomy.

Data Analysis

Analysis of quantitative data

The 17 RPBS and 19 SSCPI students answered EUAQ and SKS pretests and posttests. Their test results were analyzed.

Before deciding on the test that would be used for data analysis, a normality test was administered to identify whether the scores gathered from both groups were appropriate to normal distribution. As the numbers of both groups were less than 50, the Shapiro-Wilks test was used as the normality test (Büyüköztürk, 2009). If the p value obtained from this test is greater than .05 it is understood that the scores are appropriate to normal distribution (Büyüköztürk, 2009:42). The results of the normality test administered to the RPBS students is given in Table 3.

Table 3. Normality Test Results for RPBS students' scores

	Shapiro-Wilk		
	Statistics	**sd**	**p**
SKS –pretest	.974	16	.892
EUAQ – pretest	.963	16	.720
SKS –posttest	.951	16	.512
EUAQ – posttest	.944	16	.395

*p<.05

As it is seen in Table 3, p values gathered for both pretest and posttest scores are higher than .05. As a result it can be said that in significance level scores are appropriate to normal distribution (Büyüköztürk, 2009:42). Gathered results for SSCPI students from conducted normality tests are given in Table 4.

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Table 4. Normality Test Results for SSCPI students' scores

	Shapiro-Wilk		
	Statistics	**sd**	**p**
SKS –pretest	.913	19	.085
EUAQ – pretest	.952	19	.430
SKS –posttest	.963	19	.633
EUAQ – posttest	.942	19	.285

*p<.05

As seen in Table 4, p values obtained for both pretest and posttest scores are higher than .05. According to these results, it can be said that SSCPI students' scores are appropriate for normal distribution. Therefore, as scores from both groups are appropriate to normal distribution, the t-test was used. In order to see changes in the groups themselves "paired samples" t-test was used. In this study, the opinions of scientific knowledge as a whole are aimed to evaluate. Therefore there has not been a separate analysis of the scale sub factors.

Analysis of qualitative data gathered in the study

In this study students were expected to write compositions and draw pictures about what was learnt from the conducted activities. Picture drawing and composition writing activities were organized as contests among the students at different times. Each of the three best compositions and drawings were chosen and rewarded with a telescope as a gift for each student. These drawings and compositions were the most reflective ones in the contest. Therefore, we selected three best drawings and compositions for analysis in the study.

At the same time, by interviewing students within the scope of activities throughout the camp we aimed to learn about both their opinions and knowledge. Each interview was conducted with students in person, as well as through pictures and writings. The results were then classified into main themes identified by the researchers; Earth, astronomy, Universe, scientists interested in astronomy, historical development of astronomy, equipment used in astronomy-and the main themes' considered were coded into sub-words and sub-topics. Meanwhile, the designs in the pictures, the words, ideas, which were not in the identified themes but related to astronomy and in the scope of related activities were also identified and used in the analysis. With the help of these analyses, students' ideas and knowledge was identified. For this study,

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semi-structured interviews were conducted. All participants were individually interviewed before and after the summer camp. While representing the research results, some student quotes which were characteristic samples for the definitions at these categories were given. Qualitative data analysis is to organize understood and express the data, description of the participants about the studied situation and obtained patterns, themes, categories, and layouts in order to note down (Cohen, Manion & Morrison, 2009).

At the end of data analysis, three main themes were identified as knowledge and comments about the Earth, Moon, stars and planets, knowledge and comments about what astronomy is and its development, and scientists interested in astronomy. In accordance with these themes correlations in pictures and writings were analyzed.

Findings

During the LLAESSC, basic primary school student level astronomy concepts were studied and reinforced with activities. The students were asked some questions both before and after the LLAESSC; findings were reached based on their responses. The findings obtained are given below accordingly with the related research questions.

1. Did LLAESSC make a difference in participants' understanding of scientific knowledge?

The analysis result of SKS scores of participants from RPBS and SSCPI indicating the effects of LLAESSC on student's understanding of scientific knowledge was given in Table 5.

Table 5. Paired sample t-test results of SKS scores of RPBS and SSCPI participant

Participants	SKS	N	$\bar{X}$	ss	sd	t	p
RPBS	Pretest	17	61.56	5.56	16	1.026	0.321
	Posttest	17	63.43	6.65			
SSCPI	Pretest	19	61.52	7.47	18	0.143	0.888
	Posttest	19	61.84	5.41			

*p<.05

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It is seen from Table 5 that, RPBS participants' SKS pretest and posttest average scores were close to each other and the difference between pretest and posttest average scores was not significant (p=0.321>.05). The SSCPI participants' SKS pretest and posttest average scores were quite close to each other. Therefore, no significant difference was observed between this group's pretest and posttest results (p=0.888>.05).

2. Did LLAESSC make a difference in participants' achievement levels about their concepts of the Earth and Universe?

Analysis results identifying the effects of LLAESSC on participants' achievement about the Earth and Universe are given in Table 6.

Table 6. RPBS and SSCPI participants EUAQ Paired sample t test Results

Participants	EUAQ	N	$\bar{X}$	ss	sd	t	p
RPBS	Pretest	17	13.41	4.88	16	1.032	0.037*
	Posttest	17	16.76	3.57			
SSCPI	Pretest	19	12.89	3.51	18	1.045	0.310
	Posttest	19	14.15	4.13			

*p<.05

In Table 6, it is seen that pretest and posttest averages for RPBS participants were different and at the same time significant (p=0.037<.05). No significant difference was observed between the SSCPI participants' pretest and posttest average scores (p=0.310>.05).

Responses to the Interview Questions about the Earth and Universe (IQEU) to the EUAQ administered to the participants both at the beginning and at the end of LLAESSC

In general meaning, although the interview questions were semi structured, participants were asked to give reasons for their thoughts which turned the interview questions into open-ended form. The before and after LLAESSC sample student responses were compared for each student and are provided below with researcher comments.

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"Is it possible to observe the entire surface of the moon from the point we are? Explain the reasons."

Before the activities, one sample student responded, "No"; while another student replied, "It is possible because objects in space can be observed with the help of telescopes". At the end of the activity, the student who had previously given the "No" response stated, "The moon is not seen by us three dimensionally since we see it one sided". The student who had previously responded, "It is possible" changed his mind and said, "No". As a justification for his answer he added "One side of the moon is dark and we only see one side of the moon". Responses to these questions indicate that before the LLAESSC students had incorrect and/or inadequate knowledge. Consequently, the previous vague image in the students' mind about seeing the whole moon was clarified by the conducted activities.

"What color are the stars? Explain the reason for your answer"

Three students were chosen as samples for this question. Prior to the activity their response was "White". After the activity the first student's response was, "*There are white, orange, blue and old stars.*" The second student's response was, "*They are white, red, blue and red when they are close to dying.*" The third student replied "*White, old ones are red and ones close to dying become orange.*"

These responses indicate that students realized that stars have different developmental periods from birth until death, and may be different colors during different periods, but they do not clearly understand the relation between the colors and developmental periods.

Although the participant students has general knowledge about moon and stars, their knowledge became more detailed after the activity. Accordingly, it was concluded that the related activities were effective tools for established learning.

"Briefly explain the causes of the formation of seasons"

The question was asked to six students. Prior to the LLAESSC, three of them replied, "*It's related with the axis of the earth, the axis of the Earth causes, in summer the sun gets closer in winter it moves away.*" At the end of the activity, the same students answered the same question as, "*The Earth revolves with a 23.5° tilted axis.*" and "*Earth's rotation around Sun and 23° inclination*". Another student responded, "*The earth is moving around the sun in an oval orbit and has an inclined axis.*" In this case

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it can be argued that students can reason about the formation of the seasons or have some knowledge about it but they do not have a clear understanding. The activities completed on this topic reached their aim to a large extent. This question is aimed at enabling students to understand that the Earth is affected by events due its shape. As the causes of season formation is understood by the students, the aim is achieved to some extent.

3. How did the LLAESSC students' from RPBS and SSCPI express their opinions about the Earth and the Universe in their compositions and pictures?

The colors the participants used and the pictures they drew can be seen as visual resources with which children can easily present the views and images they have in their heads. In this case, the researchers asked the participants to draw a picture reflecting their conceptions about the Earth and the Universe. In general terms, the children imagined a colorful universe. Some children were affected by the stories told about the scientists who contributed to the development of astronomy and they chose to use them in their pictures. The samples of the pictures are presented with comments below.

***Picture 1*-A student – Researchers' comments:**

Fig 1 1-A student`s picture

This picture shows that the student perceives the universe as a colorful, crowded place but at the same time it moves in a certain order. The smile on the face of sun (near the right bottom) indicates that it is known as friendly, familiar and different from other stars. The explosions and burning in the stars are represented by two images. Depicting the Earth so big in the center means the child is looking at space

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from where he lives, loves and cares about it primarily. It is assumed that different areas with different colors separated from one another indicate the magnitude of the space with different parts. This picture can be seen as a picture where the child presented his understanding of space.

***Picture 2*-B student - Researchers' comments:**

Fig 2 2-B student`s picture

This picture illustrates the shift from the Earth centered universe model accepted by the Middle Age Christian world, to the sun centered universe model. With small messages (they built a wall in the sky) restraints on space studies in the middle ages, on the other hand the freedom in Samarkand, the Islamic world during the middle ages and the star catalogue examples are given. Two different perspectives are quite clearly depicted. In conjunction with all of them, it is seen that the child gained knowledge and developments about astronomy studies in two different cultures in middle ages, was influenced by it, and illustrated it.

***Picture 3*-C student - Researchers' comments:**

It is thought that the student aiming to show us the similarities and differences between a Galileoscope and a Telescope and for what reasons and how they are used. The well-known Ursa Major, Pole Star and falling star were drawn from student's perspective. At the same time the rotation direction of the planet and its satellites and the color of Mars are remarkable.

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Fig 3 3-C student`s picture

***Picture 4*-D student - Researchers' comments**:

Fig 4 4-D student`s picture

4-D student interpreted "the sun centered universe model" in his picture as that the sun is smiling from the corner to other stars and space objects, and watching what is going on there. In his expression, he emphasizes that our Earth is colorful and remarkable, which is rotating around the sun. The number of stars and other planets means that the vastness of the space even in the further places. However, the sun looks perceived different and bigger than other stars and space objects. He interpret the sun is different and bigger than others, because he thinks that the sun is the only

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star that lightens and heats the Earth. It can be seen on the picture that the child tried to draw burning stars (comet) with two scratches at the top of the planets. It is thought that the student also tried to draw Saturn with two rings. By the telescope image under the sun, he expresses that the space can be observed in detail. But, the location of telescope out of Earth in the space can be interpreted as human wonders and wants to learn the space.

***Writing 1*–A student – Researchers' comments**: Students' writings were read one by one and two of them were randomly chosen and analyzed in this article. At the end of the analysis the students' knowledge about the content of astronomy, scientist studied in astronomy, the development of astronomy throughout history, and the students' comments about subjects related to astronomy were considered and their relationship with the subject were attempted to be understood.

The first child whose writing was analyzed indicates that he acquired a considerable amount of knowledge about astronomy.

> *"Astronomy is a discipline that existed as a result of people's interest in space, the Earth and planets. In ancient ages people didn't have much knowledge about space, the Earth and planets. Because of the oppression of the church the Earth was known to have a flat surface. People who contradicted the church's ideas were taken to court and punished. As time passed, scientists like Fergani(Al-Fargani), Galileo, Aristotle, Biruni (Al-Biruni) came onto the stage. As a consequence of the experiments they did they proved that the shape of the Earth is ellipsoid and that the center of our solar system was the sun and the earth and other planets rotated around the sun. After that, they founded observatories to advance their studies."*

It was understood from the provided examples that the students are aware of what astronomy is, and of the important developments in astronomy, the student reference the attitudes of people towards astronomy over time and the trained scientists. The student emphasized the development of astronomy from the ancient ages through present times, and the difficulties that the scientists faced. The names of well-known scientists trained in this field are given and in general terms their contributions were mentioned as well can be clearly seen in the writing. In the following part of the writing the student mentioned that space observation was done with some equipment and the names of some planets that observed.

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> *"In observatories, bigger and more complicated scientific equipment was invented in order to examine the sky and planets. With the help of this equipment they observed planets like Mars, Saturn, Venus, and Jupiter more easily. Scientists had difficulties while doing these studies. Moreover, Galileo who contradicted the church's decision was sentenced to house detention. Briefly, scientists devoted their lives to educate and enlighten us and explore space. As a result of scientists' studies we were able to learn about space, the Earth and planets, may be here is the lesson we should get; "Societies which do not value science never advance to the future and without effort nothing can be learnt."*

It is understood from the above paragraph that the student is aware of the equipment used in space observation and of the different planets. Mentioning scientists who have worked in astronomy, especially Galileo indicates that the student is aware of the value given to science. The student's last sentence especially explains this awareness clearly *"Societies which do not value the science never advance to the future and without effort nothing can be learnt."*

***Writing 2*–B student – Researcher comments**: This is quite an original work as the student put himself in the shoes of Galileo and wrote in accordance with the knowledge he had. The writing is totally sincere, there are dialogues and judgments and it is a flexible writing. It is structured around Galileo's idea that the Earth rotates around the sun and the unfair treatment he was exposed to because of his idea. These treatments were emphasized each time. At the beginning of the writing the knowledge about Jupiter's satellites and their rotation around it were used as well.

> *"One day I was looking at the sky. While watching Jupiter I thought its satellites were rotating. If satellites are rotating around Jupiter then the earth rotates both around the sun and may be around its axis. In my opinion the Earth is round. But first I should take note about Jupiter's satellites…. I went home and in the morning I was walking down the street. Two officials held my arms. They took me away. I asked what they were doing and ordered them to release me. They told me I was invited to the court. I wondered why they asked me to court so I went. I asked the judge what I had done. The judge told me "We've heard something about you." I asked "What did you hear?" He told me "you were claiming the Earth was rotating around the sun. Is that right?" I told them "yes this is right." He shouted at me and said "how could you dare to claim that. We are the judges so far to our age we don't know this and you know that? Give up*

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your claim. Tell us that the earth is a flat surface and we will release you." As a result I accepted. While leaving the court I turned back and told them "you don't believe that (mark my words here) the earth is not a flat surface, it is round and rotates around the sun", and left the room. I think the officials are looking for me now. They could not digest what I said and they want to execute me."

This writing includes knowledge, empathy and interest in Galileo at the same time, who studied in the astronomy field. Formation of the story indicates that he internalized the situation.

Discussion and Results

In this research, we examined whether LLAESSCs resulted in any significant changes to the RPBS and SSCPI students' understanding of scientific knowledge and their academic achievement level on the Earth and Universe.

In light of the findings, it can be claimed that LLAESSC did not have any significant effect in their understanding of scientific knowledge (Table 4). This may be attributed to the brief length of the camp (5 days) for both the RPBS and SSCPI groups. Therefore, the results of this study support the other studies where a change in scientific knowledge was observed indicating a longer period of time was necessary in order to see any change in scientific knowledge level (Ünal Çoban, 2009). In this case the longitudinal studies are also recommended (Gibson & Chase, 2002). Another reason for this result may be that there was only one inventory to collect data in identifying scientific knowledge. Similarly, Çalışkan (2004) and Ünal Çoban (2009) stated in their studies that the inventory alone is not enough to identify students' conceptions of scientific knowledge, and that data triangulation is needed as a means of qualitative data collection tools.

This situation can also be due to usage of activities that are not clearly and directly related to scientific knowledge. Abd-El-Khalick & Lederman (2000) emphasize that direct clear discussions of scientific knowledge, and explicit analyses of cross-sections from science history or philosophy can change perceptions of scientific knowledge. This case makes the researchers to review the worksheets used in the project in terms of developing opinions on scientific knowledge.

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On the other hand, it was seen that although the SKS scores of both groups of students were similar at the beginning of the LLAESSC (RPBS $\bar{X}$=61.56; SSCPI $\bar{X}$=61.52), the RPBS students' average SKS scores increased a bit more than the SSCPI students' at the end of the LLAESSC (RPBS $\bar{X}$=63.43; SSCPI $\bar{X}$=61.84). Therefore, it can be claimed that the LLAESSC do further the RPBS students' understanding of scientific knowledge, albeit it is not a significant increase. The results show that both groups of students need extra, explicit and long-term support for having the idea of scientific knowledge. Another contribution of the LLAESSC to RPBS students is that it provided an opportunity to significantly change their understanding of concepts about the Earth and Universe (Table 4). In their study Bakas & Mikropoulos (2003) showed that students can explain and concretize astronomy concepts better with three dimensionally designed activities. In the study conducted by Amorim, Pereira, Liberato, Caramelo, Amraoui, Alencoao, & Reis (2009) it is seen that students learned astronomy concepts in a more meaningful way at the end of watching simulations and conducting observations with telescopes. On the other hand, the SSCPI students in the LLAES summer science camp increased their average scores at the end of camp ($\bar{X}$=14.15) compared to the beginning of the LLAESSC ($\bar{X}$=12.89). But the difference between the above average scores is not considered statistically significant (Table 5). However, in the interview data of the participants, it is seen that there is a positive improvement in their comprehension of astronomy and space concepts when compare to the beginning of the camp. Fields (2009) state that at the end of their summer camp, students expressed that they liked informal science learning experiences and they better understood astronomy subjects.

Consequently, "Let's Learn Astronomy Explore Space" summer camp did not make a significant change in RPBS and SSCPI students' opinions for scientific knowledge. However, it contributed significantly to the RPBS students' comprehension of concepts about the Earth and Universe. In the analysis of the drawings and writings it is seen that there is a positive and significant knowledge, comment and interest increase in students about astronomy, its content and scientist interested in astronomy.

In their writings and drawings, science camp helped the students to develop an opinion that space and the celestial bodies in it are not so far and frightening and lead children to explore planets and other celestial bodies.

Science courses, especially subjects including abstract concepts should be organized and practiced in a way to attract students' attention, develop higher thinking abilities

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and enable them to learn more meaningfully (Yair, 2001). However, education in our schools seems to be quite far away from helping students learn meaningfully to acquire personal abilities and contribute to the active learning process. Although the lessons students listen to are interesting, they cannot concentrate for a long time in the lesson. Students cannot get out of being a passive learner and put into practice their potential for their own learning. As a consequence, effective learning does not occur (Chen et al., 2007). For that reason, it can be claimed that in the education system new educational methods, and equipment that makes the students active, prevents distraction in a short time, and makes subjects interesting and fun are needed. It is suggested that in order to make significant changes in students' opinions for scientific knowledge, activities should be enriched with clear presentations and practices about the nature of scientific knowledge and the camp should last longer.

In their study Krstovic, Brown, Chacko & Trinh (2009) administered a survey in order to determine which activities motivate and support students' interest in astronomy. In this survey, the students chose the following activities; virtual space exploration and space station visits, interviewing with astronauts, and listening to interesting space stories. Considering the conducted study and the findings of this study it is suggested to hold camps where children can enjoy learning and do not experience any exam anxiety. Moreover, if possible, the duration of the camps should be longer in order to see any change on any variable which has resistance to change.

Conclusion

The LLAESSC was conducted with thirty-six participants from 6th, 7th and 8th grades. The activities were aimed to increase their awareness about astronomy, their knowledge about the Earth, planets and certain structures in the universe. These activities were prepared by academicians and staff. It was observed that the participants enjoyed these activities. Besides, the activities motivated and required the students to produce tangible results. As a result the students produced well.

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