

# Journal of Turkish Science Education

<http://www.tused.org>

© ISSN: 1304-6020

## Pupils' metaphors regarding the concept of astronomy in a secondary school social studies course

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*\*This study was generated within the scope of Meltem Elif Çelik's doctoral thesis, carried out under the supervision of Assoc Prof. Dr. Selma Güleç at the Institute of Educational Science of Bursa Uludağ University*

### ABSTRACT

The year 2019 was proclaimed the year of astronomy literacy by the European Astronomical Union (EAU). Several countries around the world have now started to focus more on space and astronomy endeavours and have shaped their curriculum as a result. Therefore, the perceptions and views of secondary school pupils taking social studies courses on astronomy and astronomy literacy are equally significant. The purpose of this study was to reveal the metaphors used by 5th, 6th and 7th grade pupils taking social studies courses regarding the concept of astronomy. In the present study, a metaphor application was administered to a total of 222 pupils, 74 pupils from each grade level. The research questions were "What are the metaphors of the pupils regarding the concept of astronomy?" and "Which categories are the metaphors created by the pupils related to?". The data obtained were analysed using descriptive analysis and content analysis. In the present study, it was evident that the pupils mostly associated astronomy with concepts such as space, universe, planet, and astronomy, and concretised astronomy through science and social studies concepts. Only a few of the participants, unlike the others, associated astronomy with concepts such as mine, picking flowers from the mountains, fireflies flying, the unknown, and cells. The concepts are grouped into six categories: science, science and social, social, fear, imagination and nature. The pupils associated astronomy metaphors with science ( $f$  118) the most and with the nature category ( $f$  2) the least.

### RESEARCH ARTICLE

#### ARTICLE INFORMATION

Received:

15.08.2024

Accepted:

14.03.2025

Available Online:

22.09.2025

#### KEYWORDS:

Social studies course,  
astronomy literacy,  
metaphorical  
perception, secondary  
school, pupil  
conceptualisation.

**To cite this article:** Çelik, M. E., Güleç, S., & Atasoy, E. (2025). Pupils' metaphors regarding the concept of astronomy in a secondary school social studies course. *Journal of Turkish Science Education*, 22(2), 468-487. <http://doi.org/10.36681/tused.2025.024>

### Introduction

From ancient times to the present day, the celestial bodies have always been a subject of curiosity for people (Unat, 2013). Since the beginning of their existence, human beings have looked up to the sky and have always speculated about what was happening at the point they could not reach up into the sky. They were sometimes frightened of the events that took place at a point where they could not reach up in the sky, and sometimes they deified them, but in the end, they tried to apprehend and make sense of them. and associated celestial bodies with deities. As a guide for themselves, people

realised that they could modify the work they did on Earth, the planting and sowing activities, and the control of time when they observed the sky. The efforts to make sense of the sky and the movements of celestial bodies eventually led to the emergence of the astronomy (Berea, et al., 2019; Gertsch & Gertsch, 2000, p.2; Taşcan, 2019; Unat, 2013). Therefore, astronomy commenced to develop.

Astronomy was generated by combining the Greek words "Astron", meaning celestial body, and "nomos", meaning determination and law (Göker, 2000). In Arabic, it is called *İlm-i Heyet*, *İlm-i Felek*. Astronomy fundamentally investigates space, celestial bodies in space, and the universe (Taşcan, 2019). Astronomy is a branch of science that investigates the structures of celestial bodies, explaining concepts such as the universe, space, meteor, galaxies, black holes, etc., in qualitative and quantitative terms (Pena & Quilaz, 2001, p. 1129; Düşkün, 2011, p.40). Astronomy is a systematic science that collects information from the farthest points of the universe, starting from the planet we live on and interprets this information.

In this day and age, while the International Space Station, the world's eye candy in space, the space telescopes such as Hubble and James Webb and efforts to search for signs of life on Mars and make space a livable place have been increasing, it is certainly inconceivable for Turkey to turn a blind eye and deaf ear to all these developments. Turkey has accelerated its space endeavours and established the Turkish Space Agency, established the first celestial to go into space and conduct experiments, and attempted to produce its own rocket. While the issue is so vitally crucial, many areas such as the accumulation of knowledge about astronomy, space tourism, and the space economy have emerged in Turkey and the world (Civelek & Türkay, 2019, p. 960; Yurgiden, 2023, p.3). In such a situation, it is inconceivable for the school curriculum to keep away from all these developments.

The social studies course is the integration of social and human sciences to raise functional citizens in line with the requirements of the age. (Barr et al., 1977; Güleç and Çelik, 2022). Social studies is an interdisciplinary course that aims to educate citizens who can solve problems in developing countries and existing world conditions, follow the developments in the world, and take responsibility and make decisions on critical issues (Bayar & Çepni, 2022; Demirezer & İlkörücü, 2023; Öztürk, 2009, p.2), which aligns with the aims of science education, real-life problem solvers (Ormancı, et al., 2020).

In Turkey, when considered from the perspective of the disciplines that make up its content, social studies can be traced back to the Tanzimat (Reform) period, when teaching it as a distinct subject was seriously deliberated at the 5th National Education Council held on February 4-14, 1953. The council suggested that history, geography, and civics courses be collectively taught under the name of social studies in general education. A social studies course was first introduced in teacher training colleges and village institutes in 1953 and was included in primary school programmes as a social studies course in the 1968 curriculum. In 1985, three different courses were introduced, namely national history, national geography and civics. In 1998, the social studies course was included in the curriculum once again (Çiydem & Kaymakçı, 2021, p. 180). Even though the social studies course curriculum was renewed from time to time, it was always a programme that emphasised the value of education, and the development of pupils' life skills.

The social studies course firstly aimed to ensure that people kept up with the wave of immigration from different regions, were raised with citizenship awareness, and lived in harmony (Aktan & Saylan, 2013, p.56; Bara & Xhomara, 2020; Evans, 2006, p. 319). In this sense, the social studies course has an interdisciplinary design that aims to educate individuals who can solve problems, make informed decisions, and use their rights. Many sciences, such as history, geography, citizenship, communication, law and astronomy, have been integrated into the social studies course (Sunal & Haas, 2005). While the concepts and skills related to astronomy are taught to pupils through life sciences courses in primary schools, they are taught mainly through science courses at secondary school. Nevertheless, astronomy is also a subject of social sciences; it is also among the subjects of social studies courses. (Berea et al., 2019). There is specifically a relationship between the science of astronomy, and the sciences of history, geography, economics, and psychology in the social studies course, which are discussed in this study, and it is crucially important to address the topic of

astronomy in social studies (Güleç & Çelik, 2022; Erbudak & Yeşilbursa, 2023; Salimpur et al., 2024). The topics of how people today and posterity make sense of the universe they live in, that they are fully aware of previous astronomy studies, and the impact of space on the world we live in are also present within the social studies course curriculum. It is commonly acknowledged that specifically the technological developments in this day and age, many topics such as space, life in space, space tourism, space economy and sub-disciplines have come to emerge (Yurgiden, 2023). The International Astronomical Union (IAU), which aims to integrate astronomy, which conducts studies on space, in the curriculum, emphasises that astronomy, whether it is presented as a separate course or integrated into the content of another course, should be included within the primary and secondary school curricula of all countries. All these debates have led to the acceleration of scientific studies on astronomy education (Percy, 1998). Meanwhile, Turkey have started to focus on space studies as well. For instance, as a country Turkey, which has certain space-related goals, has sent its first astronaut, Alper Gezeravcı, into the space. It is crucial to include astronomy-related subjects and concepts within the social studies courses so that future generations can keep up with the current technology age, follow the advancements in space, and be intrigued by space (Marusici & Hadzigebovic, 2018; Güleç & Çelik, 2022; Erbudak & Yeşilbursa, 2024).

Metaphor is a data collection method that allows a subject to be investigated from a broader perspective and to distinguish the similarities and differences (Arnett, 1999). Metaphor studies first emerged with the 'Mental Metaphor Theory' put forward by Lakoff and Johnson in the 1980s (Şahin & Baturay, 2013, p.178). Mental metaphor theory recognises metaphors as conceptual models that shape people's thoughts about reality and the world. Thanks to the metaphor technique, people can make abstract and complex concepts concrete and understandable, and explain the concepts they see or hear through different analogies (Cerit, 2008, p.695). Enabling conceptual development for astronomy, helping pupils to develop a positive attitude towards astronomy, space studies, astronomy professions, and studies on astronomy skills are also related to social studies. Therefore, metaphors created for the concept of astronomy are important in social studies (Kövecses, 2020). Thanks to the metaphor technique, it is possible to identify how the pupils make sense of the astronomy concepts they have learned and encountered in the social studies course, which object or concept corresponds to the astronomy concept in their minds, and how they interpret astronomy in their minds (Altun & Apaydın, 2013; Güven & Güven, 2009; Uslu et al., 2016). Clearly, metaphors can be utilised in order to help children visualise and concretise the new concepts they have encountered in the social studies course (Riejös et al., 2001; Toplu, 2015).

As far as relevant literature is concerned, there exist various studies on the subject of astronomy. Studies on teaching astronomy concepts are mainly found in the field of science education. Oğuzman et al. (2020) investigated the studies on the concept of astronomy in the field of science education, 77 articles on astronomy that were accessed in the TR Index, Google Academy and ULAKBİM database were analysed using various criteria. Regarding the results of this study, the concept of astronomy is mostly in the field of science education, which focuses on teaching concepts and that the studies on the subject have increased in recent years. Master's and doctoral theses in the field of science education on astronomy have principally focused on misconceptions about the concept of astronomy, methods and techniques to be used in teaching the concepts thereof, perceptions and attitudes of pupils, teachers, and prospective teachers towards the concept of astronomy, and planetarium and augmented reality application activities (Meyer, 2000; Palmer, 2007; Chastenay, 2016; Taşcan, 2019; Ceylan, 2023).

In this respect, there are studies examining learners' metaphors and perceptions regarding astronomy concepts (Karamustafaoğlu, & Aktürk, 2010; Bülbül et al., 2013; Sadıkoğlu et al., 2022); studies in which astronomy was taken as a study subject (Plummer, 2009; Blown, & Bryce, 2018; Shen & Confrey, 2007; Yerlikaya & Yerlikaya, 2016; Merakchi, 2018; Eriksson, 2019; Salimpur & Fitzgerald, 2022; Salimpour et al., 2024; Likavcan, 2024); and studies establishing a connection between social studies and astronomy (Ekiz & Akbaş, 2006; Berea et al., 2019; Güleç & Çelik, 2022; Erbudak & Yeşilbursa, 2023). In the field of life science, there are studies focused on augmenting the astronomy

literacy in learners through various applications (Benli- Özdemir, 2022; Benli- Özdemir, 2023); studies that identified pupils' misconceptions about astronomy (Göncü, 2013); studies that measured the self-efficacy and attitudes of science teachers and teacher candidates regarding astronomy (Demirci, 2017; Yorgancı, 2019). Studies on the development of astronomy, on the other hand, are also available in the relevant literature of history (İhsanoğlu, 2003; Erginöz, 2008; Çelik, 2022).

In this respect, there are studies examining pupils' metaphors and perceptions regarding astronomy concepts (Karamustafaoğlu & Aktürk, 2010; Bülbül et al., 2013; Sadıkoğlu et al., 2022); studies in which astronomy was dealt with as a subject (Plummer, 2009; Blown, & Bryce, 2018; Shen & Confrey, 2007; Merakchi, 2018; Eriksson, 2019; Salimpur & Fitzgerald, 2022; Salimpour et al., 2024; Likavcan, 2024); and studies establishing a connection between the social studies and astronomy (Ekiz & Akbaş, 2006; Berea et al., 2019; Güleç & Çelik, 2022; Erbudak & Yeşilbursa, 2023). In the field of life science, there are studies on increasing pupils' astronomy literacy through various applications (Benli- Özdemir, 2022; Benli- Özdemir, 2023), studies that identified pupils' misconceptions about astronomy (Göncü, 2013); and studies that measured the self-efficacy and attitudes of science teachers and teacher candidates regarding astronomy (Demirci, 2017; Yorgancı, 2019). Some studies on the development of astronomy are also available in the history literature (İhsanoğlu, 2003; Erginöz, 2008; Çelik, 2022; Çelik, 2024).

This study aimed to identify junior secondary pupils' metaphors for astronomical concepts and identify misconceptions regarding astronomy. The present study also aimed to analyse pupils' perceptions of astronomical concepts, which constitutes the cognitive dimension of astronomy literacy, based on their concretisation and analogy of the concept of astronomy. The study sought answers to the following questions in an attempt to identify the metaphors of 5th, 6th and 7th grade pupils regarding the concept of astronomy.

- A. What are the metaphors of 5th, 6th and 7th-grade pupils regarding astronomy?
- B. Which categories are the metaphors of 5th, 6th and 7th grade pupils associated with?

## Methods

This section includes the research model, data collection method, data analysis, how validity and reliability were ensured, and ethical permission.

### Research Model

The aim of the study was to reveal the metaphors of 5th, 6th and 7th grade secondary school pupils regarding astronomical concepts and how they make sense of them. For this purpose, a qualitative research method was utilised in the study. The qualitative research method provides the opportunity to analyse a subject in depth and in multi-dimensional terms (Creswell, 2017; Yıldırım & Şimşek, 2018). The phenomenological approach, which is one of the qualitative research principles, was used in the study. The phenomenological design is an approach that reflects the inner world of the individual and helps to identify the structures of consciousness (Mayring, 2000). In the present study, it was aimed to recognise and analyse the individual's perspective and conceptual connections using metaphors.

### Data Collection Tool

The data in this study were obtained using the metaphor technique. Metaphor is an important method that enables an abstract concept to become concrete. While preparing the metaphor form, the studies conducted on this subject were scrutinised (Botha, 2009; Geçit & Gencer, 2011). The data collection form was prepared in agreement with the form prepared in the relevant studies. The participants were given a question such as "*astronomy is like ..... because .....* " (Yıldırım & Şimşek, 2018). After the form was prepared, the necessary rectifications were made

by consulting two field experts in an attempt to ensure the validity of the application of the metaphor form. A pilot study was conducted with two female and two male pupils in order to test whether the form was sufficiently clear and comprehensible. Following the pilot study, it was evident that the participants successfully comprehended the metaphor form and generated concepts appropriate for the purpose of the metaphor study. After the pilot study, the application phase of the form was started.

Prior to the onset of the study, the pupils were informed about the definition of metaphor, how to concretise a concept, and were offered a few examples. Then, the metaphor instructions were distributed to the pupils. The pupils were asked to write what they likened astronomy to or how they comprehended it, and in what way they likened the concept that it was related to astronomy in the second part. They were given 25 minutes to complete the form and were asked not to define the concept for their analogies and to be careful to produce a logical basis for their analogies. The information data obtained was analysed under two headings: first, the participants' perceptions of astronomy were analysed, and then the analogy aspects were analysed with categories.

### Study Sample

After obtaining the required permissions, the metaphor tool related to astronomical literacy was administered to 222 pupils, 74 pupils each in the 5th, 6th and 7th grades in the town of Yenişehir of Bursa province in the 2021 and 2022 academic year. The participants were selected by the random method, which is a probability-based sampling method. The random method provides equal representation for each element of the sampling universe and lessens the effect of the researcher on sample selection (Reicharth & Rallis, 1994). It was stated that the privacy of the participants to whom the metaphor technique was applied would be respected, that the data would not be shared with anyone, and that their information would be kept confidential. The essential permissions were obtained during the application of the technique.

When selecting the pupils, stratified and random sampling methods of probability-based sampling were utilised. In the stratified sampling method, the participants who are thought to represent the universe from each level are selected (Baltacı, 2019). In this type of sampling, the universe is divided into subsets and samples are selected from these layers. Initially, the numbers that would represent the universe were identified equally from the girls and boys in the 5th, 6th and 7th grades using the stratified sampling method; afterwards, the pupils who would participate in the study were selected from each level based on class and gender using the random method. The analysis was performed according to the class levels, and the findings were compared with each other.

The participants were coded by their grade level and gender (5F, 6M, 7F). There were 74 participants from 5th, 6th and 7th grades, making a total of 222 participants. 37 participants were males and 37 were females in each grade. The number of participants at each grade level of the school where the study was conducted was significant in establishing the number of pupils. It was ensured that the number of participants was large so that the sample could reasonably represent the universe. Participants were nicknamed according to their grade levels, gender initials and file order. For instance, a boy from the 6th grade was coded as 6.M.1; a girl from the 7th grade was coded as 7. F.5. Participants were asked about their perceptions of the concept of astronomy. Ten of the 222 pupils' data were invalid. Some of the metaphors were deemed invalid because they were not readable, and some were left blank after the word. Grade information for invalid and valid data is illustrated in Table 1 below.

**Table 1***Distribution of invalid and valid data by grade and gender*

Grade	Invalid data			Valid data		
	Female	Male	Total	Female	Male	Total
5. grade	2	4	6	35	33	68
6. grade	2	0	2	35	37	72
7. grade	2	0	2	35	37	72
Total	6	4	10	105	107	212

Invalid data in Table 1 were excluded from evaluation. The data considered valid on the grade basis were analysed.

### Data Analysis

In qualitative studies, data are analysed by descriptive analysis or content analysis. In the present study, data were analysed using both descriptive and content analysis. Descriptive analysis consists of creating a framework, organising data according to the thematic framework, and defining and interpreting the results (Baltacı, 2019). There are five stages in content analysis. These stages are coding the data, identifying themes, organising the codes and themes, defining and interpreting the results (Dilek et al., 2018, p.585). Codes were created and themes were organised by following these stages. Two data analysis methods were utilised in this study. While identifying the categories to which the metaphors belonged, the relevant literature was reviewed, and the areas represented by the metaphors obtained in the study were predicated on this, which implies that pre-existing categories were used. In many previous studies, it was clear that the categories generated in metaphor analyses studying astronomy and astronomy-related concepts were identical (Karamustafaoğlu & Aktürk, 2016; Gürkan & Kırac, 2019; Sadıkoğlu et al., 2022). The metaphors were categorised as life science, social studies, science and social studies, fear, imagination and astronomy as nature.

### Credibility and Consistency

In qualitative studies, instead of validity and reliability, the concepts of credibility and consistency are in use (Çepni, 2021). The steps followed in the study were presented in detail in order to enhance credibility. In order to ensure the integrity of the study and the consistency of the research, it was read by an expert who completed his doctorate in social studies and a teacher who completed his doctorate degree in Turkish education. In order to ensure consistency in the study, the codes and themes generated by the researcher were compared with the codes and themes generated by the expert who completed his doctorate degree. The codes created by the researcher and the expert were all compared. The coders examined each metaphor and determined the category it could be related to. At the end of the study, the metaphors that were obtained and the categories to which they could belong were compared. The coders examined each and every metaphor and identified the category it could be related to. At the end of the study, the emerging metaphors and the categories they could belong to were compared.

In the study, Miles and Huberman's formula for determining consensus and disagreement ( $\text{Reliability} = \text{Consensus} = \frac{\text{Consensus}}{\text{Disagreement}}$ ) was used (Miles & Huberman, 1994, p.64). As a result of this analysis, it was found that the compatibility of the codes and themes was 92%. The codes and themes that were different were reviewed and arranged. In order to ensure transferability in the study, the stages of the study were explained in detail, and the participants' data were frequently included.

## Findings

### What Metaphors Do 1st, 5th, 6th and 7th-Grade Pupils Use Regarding The Concept of Astronomy?

In the metaphor study regarding the concept of astronomy, valid answers were analysed and the concepts that the participants associated with were identified. Different concepts were obtained from the available data. The frequencies and percentages of these concepts are illustrated in Table 2 below.

**Table 2**

*Pupils' metaphors regarding astronomy*

Metaphors	Frequency	%
Space	38	18
Universe	28	14
Other Metaphors	28	13
Planet	18	8
Earth	10	5
Astronomy	10	5
Research and Space Exploration	8	4
Emptiness - A Black Emptiness	7	3
Infinity	7	3
Outer Space	7	3
Science	6	3
Unknown - Things We Don't Know	5	3
Space Science	5	2
Star	5	2
Astronaut	4	2
Sun	4	2
Life	4	2
Galaxy	3	1
Black Hole	3	1
Environment	2	1
Dream -Imagination	2	1
Everything	2	1
Mathematics	2	1
Flying	2	1
Alien	2	1
Total	212	100

As is clear in Table 2 above, the majority of the participants explicated astronomy with the concept of space (*f* 38). The concept of Universe (*f* 28) was the second most associated concept. The concepts of Planet (*f* 18), Earth (*f* 10), Astronomy (*f* 10), infinity (*f* 7), outer space (*f* 7), space science (*f* 5) were the other most mentioned concepts. As far as the concepts were concerned, it is evident that the participants offered a correct analogy and definition for astronomy. These concepts are already

available in the science of astronomy. The concepts of flying (*f* 2), alien (*f* 2), and imagination (*f* 2) were also the concepts that the pupils associated the least with. The concepts under the title of Others (*f* 28) were mentioned once each. These concepts are presented in Table 3.

**Table 3**

*Metaphors that pupils expressed once*

Metaphors	
Researcher	Universe
Firefly	Dark Room
Science Fairs	Mine
Imagination	Freedom
(Like) Us	Silence
Picking Flowers from the Mountains	Infinite Place
Extraterrestrial Beings	Endless Exploration
Saving the World	Social Studies Course
Thought	Space Vehicles
Place We Travel	Space Scientist
Future	Space Depth
Sky	Space Exploration
Invisibility	Human Living in Space
Cell	Life

As is clear in Table 3 above, the concepts of space vehicle, space scientist, space depth, space exploration and people living in space were mentioned once. Comparing space to a mine was important for projects to bring mines from space now and in the near future. Establishing a connection between astronomy and mines was important in this respect. A participant established a connection between astronomy and the social studies course. This was important because astronomy was a concept in the social studies course.

### **Which Categories Are the Metaphors of 5th, 6th and 7th Grade Pupils Associated with?**

The pupils' responses starting with "because" regarding astronomy literacy helped to reveal how they interpreted the concepts they associated with astronomy. After these concepts were analysed, they were grouped into six categories. While those who defined astronomy with celestial bodies in space were directly included in the Science category, those who defined it with concepts that science and social studies dealt with together were included in the Science and Social Studies category. Definitions conveying fear and anxiety were included in the Fear category.

A detailed table was generated for the concepts included in the categories. Table 4 below illustrates the concepts included in the categories, as well as their frequencies and percentages.



**Table 4**

*Frequency and percentage distributions of the categories of metaphors produced by the pupils regarding astronomy*

Categories	Concepts	Frequency	%
Astronomy as fear	Alien	2	32
	Depth of Space	1	17
	Universe	1	17
	Emptiness	1	17
	Things We Don't Know	1	17
Total		7	100
Astronomy as nature	Firefly	1	50
	Picking Flowers from the Mountains	1	50
Total		2	100
Astronomy as a science	Space	25	21
	Universe	22	18
	Planet	16	13
	Astronomy	10	7
	Space	6	5
	Science	5	4
	Sun	4	3
	Emptiness	4	3
	Star	4	3
	Earth	3	3
	Black Hole	3	3
	Galaxy	3	3
	Space Science	3	3
	Research	2	2
	Mathematics	2	2
	Infinity	2	2
	Everything	1	1
	Cell	1	1
	Universe	1	1
	Dark Room	1	1
Total		118	100
Astronomy as a social studies	Life	4	23
	Extraterrestrials	1	7
	Saving the World	1	7
	Future	1	7
	Place We Travel	1	7
	World	1	7
	Mine	1	7
	Space	1	7
	Freedom	1	7
	Social Lesson	1	7

Total	Endless Exploration	1	7
	Human beings living in space	1	7
		15	100
Astronomy as a life science and social studies	Space and its exploration, science, everything about it	16	37
	Earth	6	14
	Space Research	5	11
	Astronaut	4	9
	Universe	3	7
	Planet	2	5
	Flying	2	5
	Science Fair	1	2
	Environment	1	2
	Spacecraft	1	2
	Space Scientist	1	2
	Research	1	2
		45	100
Astronomy as a dream	Infinity	5	20
	Unknown, the unknown	4	16
	Imagination	2	8
	Universe	2	8
	(Like) Us	1	4
	Emptiness	1	4
	Space	1	4
	Star	1	4
	Life	1	4
	It's fun	1	4
	Thought	1	4
	Endless Place	1	4
	Sky	1	4
	Invisibility	1	4
	Silence	1	4
	Space	1	4
		25	100

As far as Table 4 above is concerned, it is evident that some concepts (universe, space, emptiness, etc.) were included in more than one category. The reason for this was that the pupils interpreted them from a different perspective in the second part, where they explained the reason for the metaphor. It is clear that the participants offered most of the explanations in the science category (*f* 118).

Participants interpreted the concepts through science and attempted to define them. The concept of space (*f* 25) was repeatedly mentioned the most through science. It was evident that the participants defined astronomy through space since the concept of astronomy was defined through science in the part that started with 'because'. For instance, this is what participant 6, M.15, stated:

*"Astronomy is like space, because astronomy shows us what is happening in space and tells us what is happening."*

6.F.3 responded, *"Astronomy is like space, because there are stars, planets, meteors and meteorites there."*

The second most mentioned concept in the science category was the universe. On this subject, the participants said the following;

5.M.16, *"Astronomy is like the universe, because there are many planets and stars in the universe",*

6.F.15 *"Astronomy is like the universe, because there are, for instance, planets and stars in it".*

Among the concepts mentioned once, the *cell* was mentioned 7 times. F.12. On the same subject, 7.F.12 responded, *"Astronomy is like a cell, because there are many planets inside it, just like in a cell".*

The second highest mentioned category was space as science and social sciences (f 45). Since astronomy was a common subject of science and social sciences, the responses in this category and the connection established were significant in defining astronomy through the two sciences. This illustrates that pupils associated the concept of astronomy with both social and life scientific issues. The most mentioned concept in this category was space and space science, which is everything about space and science that explores space (f 16). Since all these concepts were used in the same sense, they were considered integrated. The participants' views on this subject are as follows;

5.M.25, *"Astronomy is like the science that explores space, because astronomy is about space";*

7.F.35, *"Astronomy is like everything about space, because astronomy is the science that investigates any information that can be obtained in space".*

Spacecraft, one of the concepts mentioned once, was mentioned by participant 6. M.7. 6.E.7 said, *"Astronomy is like space crafts because they go into the space and explores it."* As is clear in these definitions, emphasis was placed on the concepts that directly dealt with celestial bodies and science. A definition was offered only to the extent that it was covered in both social and life science textbooks. Only to the extent that they are covered in both social and life science textbooks are definitions made.

The third highest dream category was astronomy (f 25). The participants defined the concept that they found similar to astronomy with the concepts that fell into the dream category. Clearly, astronomy seemed utopian and just like a dream world to them. The most mentioned concept here was infinity (f 5). Regarding this issue, the participants stated the following;

5.M.30 *"Astronomy is like infinity, because the end of space is not visible",*

7.M.17, *"Astronomy is like infinity, because there are infinite things we don't know about the universe yet".*

The Unknown (f 4) was the second most mentioned concept. In this respect, 6.M.11 stated, *"Astronomy is like the unknown, because astronomy enables us to find all the unknown things."*

The concept of (like) *us* was mentioned by 5.F.2, which was one of the least mentioned ones. In this sense, 5.F.2 said, *"Astronomy is like us, because it is very important for our dreams."*

The fourth category was astronomy (f 15) as a social study. The participants attempted to define the concept of astronomy directly through social studies. The concepts included in this category were generated from the concepts that fell into the subjects of social life and social studies. The concept of life (f 4) was mentioned the most. In this respect, 5.M.12 said, *"Astronomy is like life itself because it contributes to our lives."* 7.F.22 said, *"Astronomy is like life because we live in it."*

One of the least mentioned concepts was the mine. In this respect, 6.M.1, *"Astronomy is like a mine, because different mines can be established in space and this will generate a lot of energy."*

The least mentioned categories were astronomy as fear (f 7) and astronomy as nature (f 2). 7 participants associated and defined astronomy with the concepts of fear. They associated and explained the concepts such as space as something we did not know and as aliens. The concept of alien (f 2) was mentioned the most in the category of fear. Regarding this issue, the participants stated the following;

5.F.28, *"Astronomy is like aliens because I don't like the space",*

7.M.27 *"When I think of astronomy, aliens come to mind because there may be other evil creatures in space."* The universe was mentioned only once in the category of fear.

In the category of astronomy as nature, one pupil likened astronomy to a firefly, while the other compared it to picking flowers from a mountain. Concepts are important in terms of

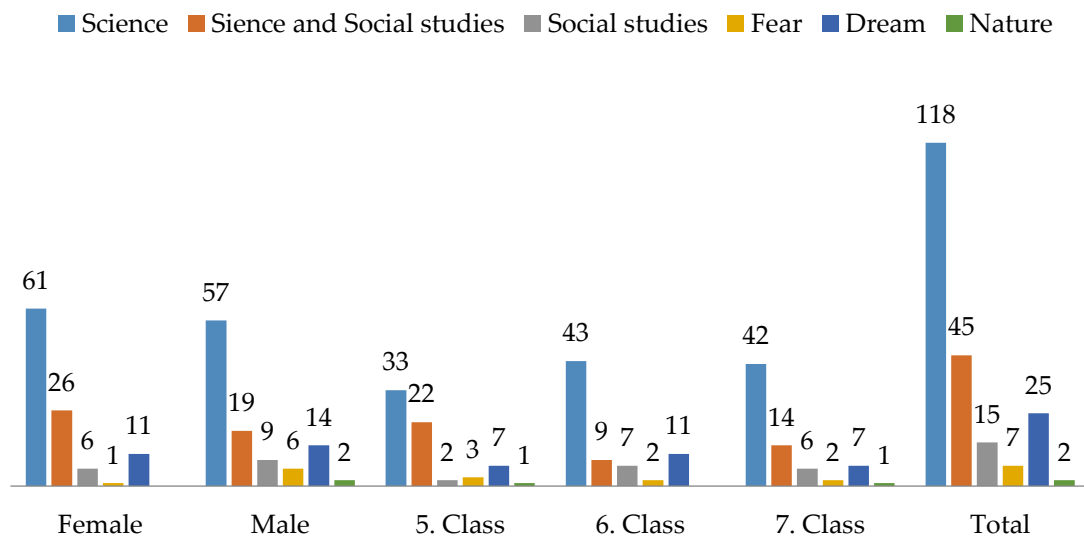
establishing an analogy between astronomy and nature. 5.M.28 stated “Astronomy is like a firefly, because when an astronomer looks into space with his telescope, he sees stars that look like fireflies”;

7.E.36, on the other hand, stated, “Astronomy is like picking flowers from a mountain, because discovering all the celestial bodies in the universe in astronomy is like picking flowers from a mountain.” They established a connection between natural elements and astronomy. When the concepts that are likened are analysed, it is evident that they establish a connection with astronomy from the right perspective.

It is crucial to compare the six categories at the class levels. The distribution based on class levels is illustrated in the graphic below.

### Graphic 1

*General distribution of the categories related to metaphors*



Regarding the Graphic 1 above, it is clear that the most connections were established between the science category ( $f$  118) and astronomy. As far as gender is concerned, the female pupils ( $f$  61) established more connections with the science category than the male pupils ( $f$  57). It is evident that the 6th and 7th grades established more connections with science based on the grade level. The second most repeated category was science and social studies ( $f$  45). The female pupils ( $f$  26) associated astronomy with both science and social studies more than the male pupils ( $f$  19). Based on the grade level, the 5th graders mostly regarded both science and social studies courses as related to astronomy. Even though there was little visual information about astronomy in the 5th-grade social studies course, the fact that they made such a connection with social studies may be related to the topics the teacher addressed in the social studies course. Fifteen pupils established a direct connection with the social studies course. Regarding gender, it was evident that the male pupils ( $f$  9) established a connection between the social studies courses and astronomy more than the female pupils ( $f$  6). Based on the grade level, 5th graders ( $f$  2) established the least and 6th graders ( $f$  7) the most direct connection with the social studies course. The reason for this particular result may be the existence of a few visuals directly related to astronomy in the 6th-grade social studies textbooks and the limited knowledge and information about observatories. The least repeated category was nature ( $f$  2). Regarding gender, only males ( $f$  2) established a connection between nature and astronomy. The reason for this result may be that the connection between astronomy and nature failed to be sufficiently established in the educational and cultural environment. It is evident that the pupils in the

5th (*f 1*) and 6th grades (*f 1*) established a connection on a class basis. By and large, it is possible to say that the pupils established a connection between astronomy and more scientific concepts as the grade level increased.

## Discussion and Conclusion

In this study, metaphors related to the concept of astronomy of 5th, 6th and 7th grade pupils were investigated. Within this framework, a total of 222 pupils' metaphors were investigated, 74 per grade. Since 10 metaphor data points were deemed invalid, 212 metaphor data points were eventually analysed. The low number of invalid data in the study demonstrated that the majority of the participants could generate valid metaphors in order to define the concept of astronomy and concretise the information. When the pupils' metaphors and justifications were compared in general, it was evident that they could partially remember the basic information about astronomy. In the analyses, the metaphor that the pupils most closely associated with astronomy was the concept of space. The universe came second. As far as their responses are concerned, it is clear that the majority of the pupils thought that astronomy explored space and the universe.

One of the pupils made a connection between astronomy and mines and stated that there were many different minerals and mines in space. This finding is significant in terms of recognising the richness of space in terms of mineral and energy resources. As far as the relevant literature is concerned, it is evident that in addition to the metaphorical studies on astronomy, the pupils also made connections between the Sun and space and the Earth in studies on the concepts of space (Karamustafaoğlu & Aktürk, 2016); Earth (Bülbül et al., 2013; İbret Ünal & Aydınözü, 2011; Rampean & Rohaeti, 2025). In the study conducted by Gürkan and Kırış (2019), in which they investigated pupils' metaphors regarding the concepts of space and satellite, it was revealed that pupils likened space to emptiness the most and a satellite to a television set. In studies examining prospective teachers' and teachers' metaphors regarding the concept of astronomy, it was determined that prospective teachers most closely resembled astronomy to the brain, while teachers most closely resembled astronomy to concepts such as infinity, the universe, and the human brain (Aslan, 2019; Uluçınar- Sağır et al., 2023).

It is possible to say that the emergent results of our study overlapped with these studies because astronomy was likened to infinity, emptiness and the universe. In the studies that investigated misperceptions about astronomy, the misconceptions could be changed with the help of conceptual change texts in such areas as planetariums and observatories through various activities, and it became easier for the pupils to make concretisations related to astronomy (Taşcan, 2019; Meyer, 2000; Palmer, 2007; Chastenay, 2016).

It was investigated which category the metaphors of 5th, 6th and 7th grade pupils were related to. The concepts that the pupils established relations with were classified in light of the answers they gave to the part of the study that started with *because*. In this context, six categories were created. The most mentioned category was astronomy as a science. The pupils explained the concept of astronomy mostly through the concepts they encountered in science. The second category was astronomy as a science and social studies. Pupils regarded astronomy as a common subject of science and social studies courses and established a connection with it because they encountered it in these courses. Astronomy as a dream was the third; astronomy as a fear was the fifth category. The least frequent belonged to the astronomical category in nature.

It was investigated in this study which categories the metaphors of the 5th, 6th and 7th grade pupils were associated with. The concepts that the pupils established a relationship with were classified in light of their responses to the part of the study that started with *'because'*. In this sense, six categories were generated. The most mentioned category was astronomy as a science. Pupils explicated the concept of astronomy through the concepts they encountered most in the life science course. In similar studies on this subject, it was clear that the pupils associated astronomy-related studies with science (Yolagiden & Bektaş, 2022; Sadıkoğlu et al., 2022). It was simply because

astronomy was also intensively studied in the science course (Gülseçen, 2002). The second category was astronomy as a life science and social studies course. In the present study, it was evident that as the grade level increased, the rate of establishing a connection with science increased as well. While the 5th graders associated astronomy with the science and social studies categories, it was clear that the 6th and 7th graders associated it more with the science category. In the previous studies conducted on this subject, it was evident that the increase in pupils' knowledge about astronomy had an impact on the metaphors they generated (Arıkurt et al., 2015; Yorgancı, 2019). The fact that astronomy concepts were addressed more in the 6th and especially 7th-grade science program compared to the other branches may be related to this particular result. As the grade levels of pupils increased, it became easier for the pupils to process the abstract concepts in their minds and create models (Serttaş & Yenilmez Türkoğlu, 2020).

Their pupils regarded astronomy as a common subject in life science and social studies courses and established relationships with them because they encountered them in these courses. Astronomy as a dream was the third category, and astronomy as a fear is the fifth one. In the study conducted by Karamustafaoğlu and Aktürk in 2016 on this subject, pupils defined the concept of space mostly abstractly through the categories of dream and fear. Specifically, the emergence of the fear category may be influenced by the pupil's erroneous learning about astronomy, misconceptions, and knowledge and information encountered in the media (aliens, UFOs, etc.) (Taşcan & Ünal, 2015; Taşcan, 2019; Gürkan & Kırac, 2019).

In the study by Gürkan and Kırac (2019), in which they investigated pupil metaphors related to space and satellites, space as science was the category with the highest frequency. Imagination and fear were the other most mentioned categories, succeeding space as science. The presence of the concept of alien in the fear category might be due to the fact that the pupils might have learnt incorrectly or structured their knowledge intuitively, devoid of scientific knowledge (Eriksson, 2019; Yağbasan & Gülçiçek, 2003). In their study on the astronomy concepts of pupils at different educational levels, Arıkurt et al. (2015) revealed that pupils had misperceptions about astronomy by considering the concept of aliens in the fear category. Nevertheless, places such as planetariums and observatories were quite instrumental in eliminating the misconceptions about astronomy or fears stemming from incorrect learning (Palmer, 2007; Meyer, 2000; Plummer, 2009).

It is compatible with the concepts of astronomy in social studies to establish a connection between the social studies course and astronomy. The concepts that pupils state about astronomy are social in content, such as profession, world, space, future, and saving the world, offered in social studies courses rather than planets and celestial bodies. In fact, Berea, Denning, Viaurri, Aracand (2019) and Remie (2019) emphasised in their studies that astronomy was also a subject of social sciences by analysing the concepts of astronomy in social sciences from an interdisciplinary perspective. Including these concepts in a more multidimensional way in social studies courses will make a considerable contribution to supporting astronomy studies in our country eliminating misunderstandings, and developing perspectives and analytical thinking skills (Taşcan, 2019; Güleç & Çelik, 2022; Erbudak & Yeşilbursa, 2023; Trumper, 2006; Rossenberg et al., 2014).

Ensuring that abstract concepts, such as astronomy, are more identifiable with metaphors and that they are linked to concrete concepts in the education process is sure to make the teaching more permanent (Shen & Confrey, 2007; Karamustafaoğlu, 2010; Sadıkoğlu et al., 2022). Nevertheless, the pupils' attitude towards astronomy also affects the level of knowledge about astronomy (Yorgancı, 2019). This particular situation makes it meaningful that the pupils in our study who developed a negative perspective towards astronomy or had misconceptions produced meaningless metaphors or concepts in the fear category.

Concretising astronomy and astronomy-related concepts is crucial in order to understand the universe and the world we live in better (Eriksson, 2019; Likavcan, 2024). In fact, astronomy perceptions can be developed through various applications and tools (Kaplan, 2011; Blown & Bryce, 2018). Astronomy enables pupils to connect with their environment and culture and, therefore, to comprehend and concretise the concept of astronomy more easily (Merakchi, 2018; Salimpur &

Fitzgerald, 2022). In this sense, identifying metaphors related to astronomy concepts, revealing misconceptions, and creating awareness about the concept in pupils will positively contribute to the correct development of the cognitive dimension of astronomy literacy (Shen & Confrey, 2007; Benli Özdemir, 2022).

### Suggestions

- Now that there exist organisms in space, the possibility of finding intelligent life has been increasing. Therefore, stories can be incorporated in course books in order to overcome the fearful alien prejudice against life in space and other intelligent life in peace.
- In social studies textbooks, a unit that covers every aspect of astronomy or a direct topic in units that can be related to astronomy can be included.
- Astronomy topics in social studies textbooks and science textbooks can be arranged in a way that supports one another.
- Social studies textbooks can be enriched in terms of advances related to astronomy.
- Current events and news related to astronomy can be included more frequently.
- The social studies course can be enriched with astronomy concepts.
- In an attempt to eliminate the misperceptions about astronomy, more precise concepts can be taught instead of concepts such as aliens that may be associated with fear.
- Metaphor techniques can be utilized to ensure that pupils can internalize and concretize the concept in educational contexts.
- Metaphors can be utilized to prevent misunderstandings before and after teaching the astronomy-related topics and concepts.
- Social studies teachers can be offered astronomy or astronomy literacy courses in their undergraduate programs.
- The present study was limited to the 2022-2023 academic year and pupils studying in the town of Yenişehir in the Bursa Province. In order to identify the pupils' astronomy concepts, studies with more participants and in different provinces can be conducted.

### Conflicts of Interest

The authors declare no conflict of interest for this research.

### Ethical Considerations

For the present study, ethical approval was obtained from the Social and Human Sciences Research and Publication Ethics Committee of Bursa Uludag University (Number: 2022/01, Date: 28.01.2022).

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