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Research

Exploring the Rich Metaphorical Representations of Basic Science Concept Among Gifted Student[1]

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Abstract:

This study explores the metaphorical perceptions of gifted students towards basic science concepts. A total of 210 gifted students participated in the study, which utilized a phenomenology design to reveal the metaphors used by students to describe the concepts of 'universe, living thing, matter, light, sound, electricity and environment'. A metaphor data collection form was used as the data collection tool. The results of the descriptive analysis showed that the most frequent metaphors used by gifted students included 'infinity' for the concept of 'Universe', 'pen' for the concept of 'Living things', 'human' for the concept of 'Matter', 'sun' for the concept of 'Light', 'wave' for the concept of 'Sound', 'water' for the concept of 'Electricity', and 'home' for the concept of 'Environment'. Overall, the study highlights the broad level of thought among gifted students when it comes to conceptualizing basic science concepts through metaphorical thinking. The findings of this study have important implications for science education and instruction, particularly in terms of promoting more creative and imaginative approaches to teaching and learning science.

Keywords: Special ability, Metaphor, Basic science concepts, Gifted students, BİLSEM (Science and Art Centre).

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INTRODUCTION

Although many definitions have been made about the concepts of superior intelligence and superior ability from past to present, they are used as "gifted and talented" in the literature (Özsoy et al., 1998). Special ability is used as a term to denote the high level of intelligence possessed. The gifted are individuals with above-average abilities and creative and critical thinking skills. In addition, they have developed problem-solving skills, a sense of responsibility, more vital reasoning skills than their peers, and the ability to solve problems and make plans. They have creative thinking and ask a lot of questions. They have high imagination and think of different alternatives to reach the goal. They can express unexpected and specialized answers. They have unique ideas. They store and memorize the knowledge they acquire (Altıntaş, 2009). Considering their characteristics, the education of gifted students is also very important. Considering the educational needs of gifted students, it is necessary to prepare activities at their own level and cognition level. Instead of thinking of gifted students as "they have high capacity anyway, they will be successful somehow," these students should be given programmed education, and they should be educated according to their abilities (Gökdere et al., 2003). Motivation problems are one of the factors that gifted students may experience and may lead to unexpected failures (Reis & McCoach, 2000). Special ability in the natural sciences is defined as a special ability area that has a high potential for scientific thinking and exhibits high-level skills in the natural sciences (Heller, 1993). Hoover (1989) presents the characteristics that should be present in gifted students in the field of science; "superior quantitative ability, superior memory, high oral ability, curiosity, freedom, use of formulas, desire to understand how a mechanism works, interest in natural sciences, wide interests and the ability to differentiate between broad interests and opinions".

The contribution of science to developing countries is a significant and indisputable fact. For this reason, great efforts have been made to improve the quality of science education. There has been a significant development in science education after World War II. In 1957, when Russia sent its first satellite into space, the United States of America, then England, and other Western countries took action. Not wanting to fall behind in technological developments, the States found a solution by renewing and modernizing the science curriculum (Ayas, 1995). Science education in Turkey has remained under the influence of developments in Western countries (Ayas, 1995). According to Özdemir (2010), studies on science literacy in our country are primarily about teachers' and students' perceptions of the nature of science and the acquisition of science literacy. In order for the nature of science to be learned by students, individuals should have acquired the concepts related to science in order to raise science-literate individuals who investigate the relationship between 'science, technology, society, and environment,' think and interpret science, develop positive interest and attitude towards science. The first aim of science education should be to teach science concepts (Kavak et al., 2006). According to Novak

(2010), the concept is the perceived pattern of objects, events, or records thereof, determined by a label. Yağbasan and Gülçiçek (2003) define the concept of science as "all of the secure knowledge gained by examining, researching, testing the events in our environment with a planned study made purposefully and by separating and integrating these concepts again." Science is not only a concept learned at school but also a concept encountered in every field in daily life that develops and advances the person (Çolak, 2014). One of the main goals of science education is to use science concepts in situations encountered in daily life, such as natural disasters, the formation of the earth and celestial bodies, water cycles, weather changes, and living diversity (Kaptan & Korkmaz, 1999).

It seems that the first studies on metaphor are based on Aristotle. For Aristotle, metaphors are implicit comparisons made according to the principles of analogy. When used outside the dictionary meaning, it is stated as a lyric art (Ortony, 2012). Lakoff & Johnson (2005) states the significance of metaphors in our lives as: "Metaphors are creative, for it directs our minds beyond existing and obvious similarities, relationships, and views to new similarities, relationships, and views of their own creation. Metaphorical thought is vital in determining people's thoughts about life, making sense of the universe, and communicating with facts, events, concepts, situations and objects (Pilav & Üstten, 2013). Metaphors are used as a tool related to language in obtaining opinions on a subject, in defining a phenomenon or object in daily life, in education, in teacher training, and consequently in all areas of life (Karapınar, 2016). Northcote & Fetherson (2006) examines metaphorical perceptions as an indicator of people's thoughts about education and suggests that people often express their feelings, perceptions, and thoughts through metaphors. Metaphors are expressed as one of the most powerful mental tools that structure, direct, control, embody concepts, and communicate our thoughts about the formation and process of concepts (De Guerrero & Villamil, 2002; Hogler et al., 2008; Shaw & Mahlios, 2011).

When the studies (Su et al., 2017; Yam et al., 2018; Kırmızı & Tarım, 2018; Özarslan, 2019; Uygur Yolçun, 2019; Epçaçan et al., 2020; Nacaroğlu & Mutlu, 2020) are conducted, it is seen that the development of metaphors effectively reveals the perception "towards concepts." Metaphoric perception is the revealing of individuals' affective perceptions about an event, phenomenon, and concept by using metaphors. Metaphorical perceptions are verbal expressions of an individual's external world perception. Metaphorical perceptions are of great importance in explaining some elements of analogy that individuals use in their daily lives, some situations that they cannot explain and revealing the situation in their minds (Tamimi, 2005). Students' perception of a course significantly affects their success in that course. In this regard, students' perceptions of the course can be revealed through metaphors. Thus, students can easily say what they want to express more effectively with fewer words by using metaphors (Toplu, 2015). Since the metaphors produced by individuals contain clues about their experiences and thinking processes, metaphors can be used as data-collection tools in scientific research (Booth, 2003).

When the related literature is examined, it is seen that metaphorical perceptions of gifted students about various concepts have been studied (Çapan, 2010; Kunt, 2012; Özsoy, 2014; Ogurlu et al., 2015; Ünal et al., 2016; Aslan & Doğan, 2016; Satmaz, 2016). In the studies of gifted students on metaphors, it was seen that the concepts were handled individually. However, it is understood that studies on gifted students' metaphors in science are limited (Aydın, 2013; İbret & Aydınözü, 2011; Aygün et al., 2015; Doğan, 2017; Yanarateş & Yılmaz, 2020; Uluay, 2020; Dinçer & Erdemir, 2020; Demirci, 2020). Through metaphors, this study addressed basic science concepts (world, universe, living, life, matter, light, sound, electricity, environment).

Although gifted students constitute a very small segment of society, the education of gifted individuals is extremely important. Because of their potential, they can change the country and even the world (Ünlü Yavaş, 2009). It is thought that the metaphorical perceptions of gifted students towards science concepts will contribute to the education of gifted students. This study aimed to explore the metaphorical perceptions of gifted students towards basic science concepts, with a focus on identifying the most frequent metaphors used for each concept. From this point of view, the problem statement of this research can be expressed as "What are the metaphorical perceptions of gifted students towards basic science concepts?". The research seeks answers to the following sub-problems within the framework of the main problem.

Sub-problems

Q1: What are the metaphorical perceptions of gifted students towards the concept of the 'universe'?

Q2: What are the metaphorical perceptions of gifted students towards the concept of 'living things'?

Q3: What are the metaphorical perceptions of gifted students towards the concept of 'matter'?

Q4: What are the metaphorical perceptions of gifted students towards the concept of 'light'?

Q5: What are the metaphorical perceptions of gifted students towards the concept of 'sound'?

Q6: What are the metaphorical perceptions of gifted students towards the concept of 'electricity'?

Q7: What are the metaphorical perceptions of gifted students towards the concept of 'environment'?

METHOD

In this study, since it is aimed to reveal the metaphorical perceptions of gifted students towards basic science concepts, phenomenology, one of the qualitative research designs, was used. The aim of factual science is to reveal the experiences, perceptions and understandings of individuals about the concept (Yıldırım & Şimşek, 2011). In this study, the basic science concepts in the science course were selected as concepts and the meanings attributed to these concepts by the students were tried to be revealed.

Participants

In this study, convenience sampling was used. Researchers may prefer individuals who are more easily accessible to make their work easy and fast (Yıldırım & Şimşek, 2011). The study was carried out in the spring semester of the 2020-2021 academic year with a total of 210 gifted students whose characteristics are given in Table 1, and who are studying in the 3rd, 4th, 5th, 6th, 7th and 8th grades of Alanya Science and Art Center affiliated to the Alanya District Directorate of National Education of Antalya in a 2-week period.

Table 1

Number of students in the working group

Group	Class	Female	Male	Total
Support training	3rd grade	21	25	46
	4th grade	9	20	29
Getting individual talents noticed	5th grade	41	39	80
	6th grade	22	15	37
Developing special capabilities	7th grade	5	6	11
	8th grade	2	5	7
Total				210

Applications Process

All of the classes where the researcher will practice, has been given the necessary information about the purpose of the application and how to do it. Students were provided with information about the research by reading the metaphor information section in the metaphor data collection form. In determining the students participating in the study, it was taken into consideration that the basic science concepts in the science curriculum were processed in their courses. When the curriculum of the science course MEB (2018) is examined, it is seen in Table 2 that the basic science concepts selected in the study are included in the program from the 3rd grade of 'universe, living thing, light, sound, electricity and environment'.

Concepts	Class	Unit Name
Universe, Matter, Environment, Light, Sound, Living Things, Life, Electricity	3rd grade	Let's Get to Know Our Planet
		Let's Get to Know Matter
		The light and sounds around us
		Journey to the World of Living Things
		Electric Vehicles
	4th grade	The Earth's Crust and the Movements of Our Earth
		Properties of Matter
		Lighting and Sound Technologies
		Human being and environment
		Simple Electrical Circuits
	5th grade	Sun, Earth and Moon
		World of Living Things
		Matter and Change
		Propagation of Light
		Human being and environment
		Electrical Circuit Elements
	6th grade	The Solar System and Eclipses
		Matter and Heat
		Sound and Features
		Transmission of Electricity
	7th grade	The Solar System and Beyond
		Pure Substances and Mixtures
		The Interaction of Light with Matter
		Electrical Circuits
	8th grade	Matter & Industry
		Energy Transformations and Environmental Science
		Electric Loads and Electrical Energy

Table 2

Science course curriculum unit names

Data Collection Tools

Metaphors can be used as data collection tools in scientific research, since there are clues about the thinking processes of individuals in the metaphors they produce (Booth, 2003). While developing the data collection tool used in the study, the data collection tools used in the research conducted to reveal metaphorical perceptions in the literature were examined (Kırmızı & Tarım, 2018; Uygur Yolçun, 2019; Nacaroğlu & Mutlu, 2020) and found out that they are in "The concept (e.g., the Universe) is like ..... Because....." form. In this study, since metaphorical perceptions are revealed, metaphor data collection form has been prepared as in literature examples. A form has been prepared that includes the basic science concepts 'universe, living thing, matter, light, sound, electricity and environment'. Gifted students were asked to fill in the blanks on the form. The word

"because" was used to explain the reasons for the metaphors that students use to express concepts (Yıldırım & Şimşek, 2011).

Data Analysis

In the analysis of the metaphors developed by the gifted students for the basic science concepts, descriptive analysis, one of the qualitative data analysis methods, was used. In descriptive analysis, connections that can express data can be reached. In descriptive analysis, similar codes are combined, arranged and interpreted in common categories and themes (Yıldırım & Şimşek, 2011). In the analysis of metaphors developed by gifted students, a five-stage process was followed, namely "coding and extraction, compiling sample metaphor images, category development, ensuring validity and reliability, and quantitative data analysis", respectively (Saban, 2009).

Coding and Extraction Phase

Each student's data collection form is encoded and numbered as S-1, S-2, ... All of the metaphors produced by the students were encoded into the excel file and an alphabetical list was created. In line with this list, it was examined whether a certain metaphor was clearly explained in the forms collected from the students. In the analysis of the data obtained in the study, the metaphors developed by the students regarding the basic science concepts and their reasons were examined and those who did not make meaningful explanations were weeded out. Some examples of student metaphors extracted from the study are as follows S32 *"Matter is like flowers. Because they smell good."*, S47 *"Life is like a snowball that is baked. Because it gets better when it's cooked"*. After the elimination, the metaphor data collection form of 210 students was included in the research.

Sample Metaphor Image Compilation Phase

After the extraction process, the metaphors were again arranged in alphabetical order and the raw data was reviewed a second time and a sample metaphor expression was selected from the student sentences representing each metaphor. Thus, for each of the 1446 metaphors, a "list of sample metaphors" was created, along with the compilation of student metaphor images that are assumed to best represent it.

Category Development Phase

The metaphors developed by the students are combined into the same categories, with similar answers combined. While determining the categories, both the metaphors developed by the students and the "because ..." part explaining the reason for the metaphor were taken into account. In the metaphors developed by some students, the thought to be explained after the part was the same, while in some students it was different. A total of 1446 metaphors developed by gifted students were collected in 52 categories according to their common characteristics.

Ensuring Validity and Reliability Phase

Since the analysis stages of the data obtained in the study were explained in detail, the validity of the study was ensured (Yıldırım & Şimşek, 2011). The reliability of data analysis was calculated using the formula [Consensus/ (Consensus + Disagreement) x 100] proposed by Miles & Huberman (1994). In order to ensure the reliability of the data obtained in the study, the opinion of an expert who has conducted research on metaphors was consulted as to whether the 39 categories developed by the researcher included the metaphors developed by gifted students. For this purpose, an alphabetical list of 439 metaphors and a list of the characteristics of 39 categories were submitted to the expert opinion and the metaphors were asked to be placed in categories. The categories determined by the researcher were compared with the categories determined by the expert. In the metaphors in this study, approximate reliability values for each concept between the researcher and the expert were determined in the range of 90% and 95%.

Quantitative Data Analysis Phase

For each concept examined in this study, a separate frequency table was made for the metaphors produced and all the data representing their categories.

Ethical considerations

Ethical Review Board: Alanya Alaaddin Keykubat University Social and Human Sciences Scientific Research Ethics Committee Decision

Date of Ethics Review Decision: 30.09.2021

Ethics Assessment Document Issue Number: 2021/06

RESULTS

Findings related to the First Problem of the Research

The metaphors developed by gifted students for the concept of "Universe", the categories of metaphors and the findings obtained from metaphor examples are shown in Table 3.

Table 3

Metaphors for the concept of the universe, its categories and sample metaphors

Categories	Metaphors	Frequency	Sample metaphors
Astronomy	Infinite	25	*S30 "The universe is like infinite. Because the beginning and end of the universe are not clear."*
	Darkness	6	*S15 "The universe is like darkness. Because the universe has no beginning and no end, it is dark and constantly expanding."*
	Space	5	*S123 "The universe is like space. Because it's just bigger than space."*

	Sky	4	*S81 "The universe is like the sky. Because the sky, like the universe, contains many things."*
	Star	3	*S76 "The universe is like star. Because if you look at it from one point of view, there are so many stars."*
	Bottomless	2	*S74 "The universe is like planet. Because when you look at the universe from the outside, it looks dark, but when you go inside, we see that there are a lot of planets."*
	Planet	2	*S85 "The universe is like bottomless. Because when I look up at the stars, I think about how bottomless it is."*
	Astronomy	1	*S209 "The universe is like astronomy. Because the universe is the foundation of astronomy."*
Place	Country	12	*S3 "The universe is like country. Because just as galaxies, planets, and stars are in a system from large to small in the universe, so there are states, cities, counties, towns and villages in the country."*
	Home	6	*S45 "The universe is like home. Because we have everything we need."*
	Field	3	*S78 "The universe is like field. Because it contains different objects like a field."*
	Anthill	2	*S172 "The universe is like anthill. Because it's so big and complicated."*
	Class	2	*S153 "The universe is like class. Because the galaxies in it, the students in the classroom, are like a class in the universe that has them in it."*
	Location	2	*S34 "The universe is like ground. Because it's too big."*
	Apartment building	1	*S101 "The universe is like apartment building. Because it has different floors in it, like an apartment."*
	Human body	1	*S204 "The universe is like human body. Because our veins, our cells, we carry the universe within ourselves."*
	Terrain	1	*S91 "The universe is like terrain. Because everything in the universe occupies a huge area."*
	Market	1	*S34 "The universe is like market. Because it has a lot of stuff in it."*
	Factory	1	*S37 "The universe is like factory. Because it always produces stars."*
	Huge place	1	*S150 "The universe is like school. Because it teaches us what we don't know has its own rules (the laws of physics) that lead us to investigate."*
	Collection location	1	*S142 "The universe is like collection location. Because there are thousands of items in the back of the unique shelf waiting to be noticed."*
	Institution	1	*S5 "The universe is like institution. Because there is a certain order in it."*
	School	1	*S150 "The universe is like school. Because it teaches us what we don't know has its own rules (the laws of physics) that lead us to investigate."*
Item	Box	5	*S208 "The universe is like box. Because a lot can fit*

			into the universe just like a cardboard box."
	Balloon	3	*S65 "The universe is like balloon. Because there is no end to the universe, it expands as centuries go by."*
	Book	3	*S17 "The universe is like book. Because there is information in it waiting to be learned."*
	Bag	2	*S113 "The universe is like bag. Because you can put anything you want in it."*
	Paper	2	*S79 "The universe is like paper. Because the shape of the universe is flat, or very close to flat."*
	Billiard ball	1	*S19 "The universe is like billiard ball. Because it has a lot of orbicular assets in it."*
	Bead box	1	*S152 "The universe is like bead box. Because there are so many round things in it."*
	Empty container	1	*S113 "The universe is like empty container. Because you can put anything you want in it."*
	Cupboard	1	*S167 "The universe is like cupboard. Because there are different things on every shelf in the cupboard, and there are other planets and stars all over the universe."*
	Baking tray	1	*S119 "The universe is like baking tray. Because the baking tray is also big and black."*
	Carpet	1	*S82 "The universe is like carpet. Because the patterns of the carpet are planets and the edges are celestial bodies."*
	Mandala	1	*S193 "The universe is like mandala. Because the universe has a perfect harmony."*
	Matrushka	1	*S83 "The universe is like matrushka. Because as we investigate and open, new things are discovered."*
	Nylon Bag	1	*S134 "The universe is like nylon bag. Because it surrounds us."*
	Clock	1	*S58 "The universe is like clock. Because just as we don't know when the clock's battery will run out, we don't know when the universe will end."*
Nature	Ocean	7	*S129 "The universe is like ocean. Because it contains a lot of mysteries in its vast interior."*
	Sea	6	*S75 "The universe is like sea. Because the sea is like eternal, and the creatures in it are like stars and planets."*
	Rainbow	2	*S102 "The universe is like rainbow. Because there are things of all colors in the universe."*
	Beach	2	*S67 "The universe is like beach. Because beach is also a whole, but it's made up of billions of grains of sand."*
	Water	1	*S52 "The universe is like water. Because its tip is not as obvious as water."*
	Waterfall	1	*S11 "The universe is like waterfall. Because it's both quiet and hectic."*
	Snowflake	1	*S69 "The universe is like snowflake. Because the beings in the universe are as numerous and dissimilar as snowflakes."*
	Entity	1	*S41 "The universe is like entity. Because when you look at the universe, you see a void, but it's not that simple. The galaxies, planets, stars in it are all part of*

			the universe."
Living thing	Tree	3	*S32 "The universe is like tree. Because its leaves and fruits look like planets and things like meteors."*
	Mother	2	*"S36 "The universe is like mother. Because it embraces everything."*
	Human being	2	*S73 "The universe is like human being. Because every person's body works with a system."*
	Living thing	2	*S132 "The universe is like living thing. Because it's constantly growing."*
	Flower	2	*S190 "The universe is like flower. Because the universe is in order, and so is the flower."*
	Coronavirus	1	*S156 "The universe is like coronavirus. Because the coronavirus is constantly spreading."*
Mathematics	Number	5	*S28 "The universe is like number. Because numbers are infinite like the universe."*
	Round	1	*S56 "The universe is like round. Because all the planets are round, I see them as round in photographs and documentaries."*
	Circle	1	*S64 "The universe is like circle. Because it has an infinite diagonal."*
	Ray	1	*S174 "The universe is like ray. Because there is no end to the ray."*
	Pi number	1	*S60 "The universe is like Pi number. Because it goes on forever."*
	Shape	1	*S100 "The universe is like shape. Because shapes are infinite like the universe."*
	Infinity sign	1	*S56 "The universe is like infinity sign. Because the universe has no limits."*
Cognitive	The human brain	1	*S84 "The universe is like human body. Because the universe encompasses everything, and the human brain receives whatever information it wants."*
	Infobox	1	*S126 "The universe is like infobox. Because even though we examine a different place every day, it can be endlessly fascinating, uplifting, and sometimes dangerous."*
	Computer	1	*S145 "The universe is like computer. Because everything happens in it."*
	Magic circle	1	*S25 "The universe is like magic circle. Because a magic circle is difficult to solve and understand."*
	Mind	1	*S12 "The universe is like mind. Because the beginning and the end cannot be determined."*
	Imaginary	1	*S22 "The universe is like imaginary. Because it's more extraordinary than we could have ever imagined."*
Food	Soda	1	*S136 "The universe is like soda. Because there are a lot of bubbles in the soda, like planets and stars."*
	Hodgepodge	1	*S94 "The universe is like hodgepodge. Because there's a lot of stuff in it that we're almost as numerous as we can call it."*
	Fruit platter	1	*S140 "The universe is like fruit platter. Because it contains many planets and objects."*

Life	Life	2	*S175 "The universe is like life. Because the life of the universe is similar to our life."*
	Everything	1	*S183 "The universe is like everything. Because it encompasses everything."*
Total	70	165	

When Table 3 shows, the metaphors developed by gifted students for the concept of "universe" are collected in nine categories. The categories are formed by taking into account the students' justifications for the metaphor and the common features of the metaphors. These categories are: Astronomy is a category of place, item, nature, living things, mathematics, cognitive, food, and life. When Table 3 is examined, the most developed metaphors of the concept of "universe" are: Metaphors of infinity (f=25), country (f=12), ocean (f=7), darkness (f=6), home (f=6), sea (f=6), space (f=5), box (f=5) and number (f=5).

Findings related to the Second Problem of the Research

The metaphors developed by gifted students for the concept of "Living Thing", the categories of metaphors and the findings obtained from metaphor examples are shown in Table 4.

Table 4

Metaphors for the concept of the living thing, its categories and sample metaphors

Categories	Metaphors	Frequency	Sample metaphors
Item	Pen	5	*S97 "Living Thing is like pen. Because the pen writes and eventually runs out, so does the living thing."*
	Machine	5	*S83 "Living Thing is like machine. Because there are organs and systems in it that work in harmony with each other, such as circuits."*
	Book	3	*S50 "Living Thing is like book. Because everyone has different information."*
	Car	3	*S120 "Living Thing is like car. Because living things move and so do cars."*
	Ball	2	*S110 "Living Thing is like ball. Because everyone kicks it even though it's not its fault."*
	Item	2	*S80 "Living Thing is like item. Because it exists, it works for a while, then it gets old and disappears."*
	Picture table	1	*S114 "Living Thing is like picture table. Because even in a painting there are people and animals."*
	Model	1	*S208 "Living Thing is like model. Because it breaks easily, but it's hard to do."*
	Vase	1	*S28 "Living Thing is like vase. Because when it's broken, it's hard to fix."*
	Sails	1	*S89 "Living Thing is like sails. Because it always discovers new things."*
	Attire	1	*S124 "Living Thing is like attire. Because when you move, so does it."*

	Door	1	*S105 "Living Thing is like door. Because it goes back and forth all the time."*
	Iron	1	*S63 "Living Thing is like iron. Because if we don't take care of it, it will rust."*
	Notebook	1	*S7 "Living Thing is like notebook. Because every day of it is like a page."*
	Bag	1	*S102 "Living Thing is like bag. Because its brain is full like bags."*
	Glass	1	*S17 "Living Thing is like glass. Because if you don't act sensitively, it will break."*
Kinds of living things	Human, animal and plant	6	*S128 "Living things are like human beings, animals and plants. Because living things consist of three groups."*
	Flower	3	*S163 "Living Thing is like flower. Because it comes into the world and fades after a while."*
	Tree	3	*S161 "Living Thing is like tree. Because trees are alive."*
	Seed	2	*S29 "Living Thing is like seed. Because it grows and develops."*
	Plant	2	*S59 "Living Thing is like plant. Because every living thing has a cycle."*
	Animal	2	*S16 "Living Thing is like animal. Because they are also a living thing."*
	Leaf	1	*S172 "Living Thing is like leaf. Because it has a beginning and an end, and when it ends, it is replaced by a new one."*
	Bevy	1	*S170 "Living Thing is like bevy. Because there are many and full of varieties."*
	Dove	1	*S139 "Living Thing is like dove. Because they're free."*
	Chick	1	*S27 "Living Thing is like chick. Because it comes to life in the egg, and we are in the world."*
Technology	Robots	8	*S162 "Living Thing is like robot. Because it acts according to the commands that the brain gives it."*
	Means of transport	1	*S137 "Living Thing is like means of transport. Because it's constantly on the move."*
	Technology	1	*S67 "Living Thing is like technology. Because it's getting better by the day."*
	Fingerprint	1	*S62 "Living Thing is like fingerprint. Because every living thing is special."*
	Computer	1	*S207 "Living Thing is like computer. Because the living thing holds information in its brain."*
	Television	1	*S5 "Living Thing is like television. Because television cannot function without electricity, and living things cannot function without oxygen."*
	Toy	3	*S55 "Living Thing is like toy. Because when you set the toy, it starts to move, and when its time is up, it stops, just like our heart."*
	Puppet	2	*S140 "Living Thing is like puppet. Because it is a puppet of its own brain."*

Game	Jigsaw	1	*S145 "Living Thing is like jigsaw. Because when the pieces are complete, you can understand what happened."*
	Sudoku	1	*S49 "Living Thing is like sudoku. Because they're both complicated."*
	The king in chess	1	*S187 "Living Thing is like the king in chess. Because we can be checkmates with the slightest mistake."*
	A toy doll with batteries	1	*S30 "Living Thing is like a toy doll with batteries. Because it's moving all around."*
	Toy car	1	*S131 "Living Thing is like toy car. Because I don't know why, but they can both move."*
	Game	1	*S118 "Living Thing is like game. Because most of living things play games."*
	Puzzle	1	*S11 "Living Thing is like puzzle. Because it seems easy to solve, but it is difficult."*
	Remote-controlled car	1	*S73 "Living Thing is like remote controlled car. Because a living thing moves with its brain, and a car moves with a controller."*
Sky	Universe	3	*S150 "Living Thing is like universe. Because it has so much to discover, like the universe, it's made up of trillions of pieces."*
	Rainbow	2	*S70 "Living Thing is like rainbow. Because it's as colorful and enchanting as the rainbow."*
	Cloud	2	*S138 "Living Thing is like cloud. Because it reacts to the outside in different situations."*
	Space	1	*S133 "Living Thing is like space. Because living things grow up and so does space."*
	Planet	2	*S126 "Living Thing is like planet. Because they are very diverse, they all have different structures. "*
	World	2	*S160 "Living Thing is like world. Because all living things live in the world."*
Human	Human being	6	*S43 "Living Thing is like human being. Because it is like a human being because of its qualities such as growth, development, excretion, reproduction and dying."*
	Army	2	*S33 "Living Thing is like army. Because there are so many living things in the world."*
	Baby	1	*S168 "Living Thing is like baby. Because they also need care and want to live."*
	Student	1	*S185 "Living Thing is like student. Because it has a lot to learn from life."*
	Servant	1	*S22 "Living Thing is like servant. Because they do similar things all the time in life."*
Necessity for life	Water	4	*S149 "Living Thing is like water. Because without water, there is no living thing."*
	Organ	2	*S182 "Living Thing is like organ. Because living things see and feel."*
	Heart	2	*S189 "Living Thing is like heart. Because it works like a heart for a very long time and doesn't die without a factor like it."*

	Breath	1	*S1 "Living Thing is like breath. Because all living things breathe."*
	Oxygen	1	*S166 "Living Thing is like oxygen. Because it can't live without it."*
	Life	1	*S202 "Living Thing is like life. Because every living thing lives."*
Facts of life	Purpose	1	*S85 "Living Thing is like purpose. Because it is born for a cause, grows up and dies."*
	Road	1	*S34 "Living Thing is like road. Because it has a beginning and an end."*
	Day	1	*S68 "Living Thing is like day. Because life goes by so quickly, like days."*
	Source	1	*S148 "Living Thing is like source. Because living thing produces many things."*
	Career	1	*S3 "Living Thing is like career. Because living things have periods of growth and development like careers."*
	Differences	1	*S39 "Living Thing is like differences. Because the characteristics of every living thing are unique."*
	Loop	1	*S164 "Living Thing is like loop. Because every living thing is born, grows, lives and dies, there is no exception."*
Nature	Fire	2	*S129 "Living Thing is like fire. Because it is both dangerous and innocent."*
	Dust	1	*S60 "Living Thing is like dust. Because it's everywhere."*
	Forest	1	*S180 "Living Thing is like forest. Because the lungs of living things are like forests."*
Art	Colour	3	*S100 "Living Thing is like colour. Because it's varied."*
	Artworks	2	*S12 "Living Thing is like artwork. Because sometimes we don't immediately notice the very difficult and very easy aspects."*
Place	Factory	3	*S46 "Living Thing is like factory. Because it can take something and produce something different."*
Entity	Entity	2	*S147* "Living Thing is like entity. *Because every living thing is an entity.*"
Total	73	133	

When Table 4 shows, the metaphors developed by gifted students for the concept of "living thing" are collected in twelve categories. These categories are: Item, kinds of living things, game, technology, sky, human, necessity for life, the facts of life, art, nature, place and entity categories. When Table 4 is examined, the most developed metaphors of the concept of "living thing" are: Robot (f=8), human, animal and plant (f=6), human (f=6), pen (f=5), machine (f=5) and water (f=4) metaphors.

Findings related to the Third Problem of the Research

The metaphors developed by gifted students for the concept of "Matter", the categories of metaphors and the findings obtained from metaphor examples are shown in Table 5.

Table 5

Metaphors for the concept of the matter, its categories and sample metaphors

Categories	Metaphors	Frequency	Sample metaphors
Living thing	Human being	8	*S185 "Matter is like human being. Because a human being who occupies space in a vacuum is matter."*
	Chameleon	4	*S145 "Matter is like chameleon. Because it can enter into any shape (solid liquid gas)."*
	Friend	2	*S146 "Matter is like friend. Because it's with us everywhere, all the time."*
	Living thing	2	*S139 "Matter is like living thing. Because some substances are moving."*
	Animal	2	*S63 "Matter is like animal. Because there are so many varieties."*
	Tree	1	*S173 "Matter is like tree. Because there are so many leaves in the tree and there is so much matter in the world."*
	Child	1	*S153 "Matter is like child. Because as children develop and change, so do substances."*
	Coronavirus	1	*S92 "Matter is like coronavirus. Because it's everywhere."*
Matter	Everything	6	*S14 "Matter is like everything. Because almost everything in our lives is matter."*
	Object	3	*S65 "Matter is like object. Because matter is an object that occupies space in the universe."*
	Entity	3	*S199 "Matter is like entity. Because substances are like entity."*
	Volume and mass	1	*S71 "Matter is like things with volume and mass. Because it takes up space."*
	Must	1	*S13 "Matter is like must. Because without matter, there can be no human and no life."*
	Something concrete	1	*S191 "Matter is like something concrete. Because we can see and touch matter."*
	Living thing and inanimate	1	*S31 "Matter is like everything living and inanimate. Because it occupies a place on Earth."*
Item	Item	6	*S16 "Matter is like item. Because when I say matter, the first thing that comes to my mind is the items that work for us."*
	Table	2	*S15 "Matter is like table. Because it has mass, it takes up space, I can touch it."*
	Pen	1	*S207 "Matter is like pen. Because* the *pen is a matter."*
	Car	1	*S179 "Matter is like car. Because the car is a matter."*
	Remote Control	1	*S35 "Matter is like remote control. Because just as the channels change when we press the remote control, so do the properties of matter."*

	Diamond	1	*S52 "Matter is like diamond material. Because every matter has a value."*
	Phone	1	*S25 "Matter is like phone. Because matter looks simple on the outside, like the phone, but is complicated on the inside."*
	Ball	1	*S140 "Matter is like ball. Because it can be big or small."*
	Eraser	1	*S206 "Matter is like eraser. Because eraser is a matter."*
Food	Water	9	*S5 "Matter is like water. Because it can be found in many forms."*
	Mixed toast	1	*S125 "Matter is like mixed toast. Because different substances can be mixed and other substances can be obtained. "*
	Food	1	*S177 "Matter is like food. Because there are different shapes and so many more than that. "*
School	Science	3	*S137 "Matter is like the natural sciences. Because almost all subjects are about matter."*
	Experiment	2	*S176 "Matter is like experiment. Because it is found by trying."*
	Book	2	*S50 "Matter is like book. Because just as each book contains different information, substances are also different."*
Toys	Play dough	4	*S117 "Matter is like play dough. Because matter takes shape, so does dough."*
	Lego	2	*S79 "Matter is like lego. Because matter is made up of atomic particles, we can combine legos to form shapes."*
	Jigsaw	2	*S150 "Matter is like jigsaw. Because there are puzzle pieces (atoms) that make it up."*
Sky	Air	5	*S133 "Matter is like air. Because it's everywhere."*
	Star	2	*S167 "Matter is like star. Because there is matter everywhere, and there are stars everywhere in the sky."*
State of Matter	Solid	3	*S100 "Matter is like solid. Because there are substances that are solid."*
	State	3	*S202 "Matter is like state. Because every matter has a state."*
	Ice	1	*S93 "Matter is like ice. Because it can be broken."*
Micro Size	Cell	2	*S204 "Matter is like cell. Because it is the structure that makes up everything."*
	Atom	1	*S60 "Matter is like atom. Because it's everywhere."*
	Nucleus	1	*S161 "Matter is like kernel. Because nucleus is part of matter."*
	Drop	1	*S66 "Matter is like drop. Because matter takes up space with its granular structure."*
	Seed	1	*S70 "Matter is like seed. Because it's the beginning*

			of everything."
Emotion	Feel	2	*S38 "Matter is like feeling. Because when we touch a matter, we feel it."*
	Family	1	*S144 "Matter is like family. Because it's with us everywhere, all the time."*
	Emotion	1	*S41 "Matter is like emotion. Because it can change like emotions."*
	Entertainment	1	*S143 "Matter is like our source of entertainment. Because some of the substances are fun."*
	Love	1	*S12 "Matter is like love. Because* sometimes *we feel it so strongly, and sometimes we don't feel it at all."*
Place	World	2	*S109 "Matter is like world. Because there are many living things in the world."*
	Lake	1	*S2 "Matter is like lake. Because it contains more than one species."*
	Universe	1	*S86 "Matter is like universe. Because it is made up of tiny things, and both came into being from nothing, and they are both perfect."*
Feature	Volume	2	*S23 "Matter is like volume. Because without volume, there is no matter."*
	Mass	1	*S147 "Matter is like mass. Because every matter has a mass."*
Nature	Sand	2	*S138 "Matter is like sand. Because it can take different shapes."*
	Nature	1	*S119 "Matter is like nature. Because there are so many varieties."*
Art	Picture	1	*S101 "Matter is like picture. Because there are different varieties."*
	Painting	1	*S162 "Matter is like painting. Because when we look at it, we can understand what it is."*
Enigmatic	Magic	1	*S85 "Matter is like magic. Because it can go from one shape to another."*
Total	60	119	

When Table 5 shows, the metaphors developed by gifted students for the concept of "matter" are collected in fifteen categories. These categories are: Living thing, matter, item, food, school, toy, sky, state of matter, micro size, emotion, space, feature, nature, art and enigmatic. When Table 5 is examined, the most developed metaphors of the concept of "matter" are: Water (f=9), human (f=8), everything (f=6), item (f=6), Air (f=5), Object (f=5) and Play dough (f=4) metaphors.

Findings related to the Fourth Problem of the Research

The metaphors developed by gifted students for the concept of "Light", the categories of metaphors and the findings obtained from metaphor examples are shown in Table 6.

Table 6

Metaphors for the concept of the light , its categories and sample metaphors

Categories	Metaphors	Frequency	Student metaphors
Light source	Sun	36	*S80 "Light is like the sun. Because it emits heat and light."*
	Lantern	4	*S40 "Light is like the lantern. Because it illuminates where it is."*
	Candle	4	*S174 "Light is like candle. Because candles are as warm and bright as light. "*
	Fire	3	*S42 "Light is like fire. Because fire also illuminates, and they both move very fast and appear from afar."*
	Lamp	3	*S122 "Light is like lamp. Because the lamp shines light."*
	Light bulb	2	*S180 "Light is like light bulb. Because the bulb emits light like it."*
	Lighting tool	1	*S128 "Light is like lighting tool. Because in my brain, the word light evokes a means of illumination."*
	A source that illuminates the surroundings	1	*S191 "Light is like a source that illuminates the surroundings. Because with light we see around us."*
Natural Phenomena	Knowledge	7	*S155 "Light is like knowledge. Because light spreads like knowledge."*
	Sound	7	*S74 "Light is like sound. Because it spreads to the environment where it is located."*
	Electricity	5	*S133 "Light is like electricity. Because they're both very fast."*
	Bright	5	*S184 "Light is like bright. Because the rays of light are also bright."*
	Seeing	4	*S1 "Light is like seeing. Because we can see around us through light."*
	Energy	2	*S83 "Light is like energy. Because light is a form of energy."*
	Lighting	1	*S51 "Light is like lighting. Because it makes the surroundings visible."*
	Heat	1	*S50 "Light is like heat. Because it spreads."*
On life	Life	3	*S39 "Light is like life. Because there is no life without light."*
	Idea	2	*S204 "Light is like idea. Because it enlightens, it provides awareness. "*
	Hope	2	*S19 "Light is like hope. Because we always expect a light in the dark."*
	Road	2	*S47 "Light is like road. Because it always shows the goal."*
	Line	1	*S176 "Light is like line. Because it spreads linearly. "*
	Gossiping	1	*S203 "Light is like gossiping. Because both light and gossip spread quickly."*
	Inspiration	1	*S67 "Light is like inspiration. Because it enlightens people."*
	Guide	1	*S41 "Light is like guide. Because it always guides*

			us."
	Message circulating on social media	1	*S91 "Light is like a message spread on social media. Because it's so fast. "*
	Life	1	*S28 "Light is like life. Because without light we can't live."*
Technology	Race car	4	*S78 "Light is like race car. Because the speed of light is so fast, it's like a race car."*
	Jet	2	*S49 "Light is like jet. Because they're both fast. "*
	Teleportation machine	1	*S139 "Light is like teleportation machine. Because it's so fast."*
	Maglev train	1	*S135 "Light is like Maglev train. Because they're both fast."*
	Engine	1	*S134 "Light is like engine. Because it is as fast as the engine. "*
Human	Teacher	4	*S121 "Light is like teacher. Because teachers enlighten their students. "*
	Human being	2	*S21 "Light is like human being. Because they both give direction."*
	Family	1	*S208 "Light is like family. Because family lights up the way for us."*
	Child	1	*S87 "Light is like child. Because it radiates hope."*
	Leader	1	*S140 "Light is like leader. Because it brightens horizons."*
Required to see	Eye	9	*S35 "Light is like eye. Because when the eye is opened, we see, when we close it, we cannot see it just like light."*
Sky	Rainbow	2	*S69 "Light is like rainbow. Because there are the colors of the rainbow in it."*
	Air	2	*S152 "Light is like air. Because it's intangible."*
	Galaxy	1	*S187 "Light is like galaxy. Because they both shine."*
	Small sun	1	*S197 "Light is like small sun. Because the sun makes light."*
	Star	1	*S63 "Light is like star. Because it's visible, but it's untouchable."*
Item	Mirror	1	*S114 "Light is like mirror. Because even if you reflect the light, the mirror reflects the light back to the other side."*
	Glasses	1	*S5 "Light is like glasses. Because it allows us to see."*
	Pearl	1	*S96 "Light is like pearl. Because it's brilliant."*
	Air conditioner	1	*S109 "Light is like air conditioner. Because like air conditioning, light spreads almost everywhere."*
	Arrow	1	*S79 "Light is like arrow. Because it moves linearly like an arrow."*
	Stick	1	*S173 "Light is like stick. Because it spreads linearly."*

Living thing	Firefly	2	*S162 "Light is like firefly. Because it illuminates where it is."*
	Cheetah	1	*S157 "Light is like cheetah. Because it's so fast."*
	Anglerfish	1	*S95 "Light is like anglerfish. Because they both radiate."*
	Tiger	1	*S132 "Light is like tiger. Because it's so fast.*
Emotion	Touch	1	*S68 "Light is like touch. Because it is as if it will be touchable by emitting light everywhere. "*
	Ghost	1	*S146 "Light is like ghost. Because we can't touch it, but we see it."*
	Morning	1	*S77 "Light is like morning. Because morning is glow."*
	End of the tunnel	1	*S105 "Light is like the end of the tunnel. Because the end of the tunnel illuminates the tunnel."*
	Mind	1	*S12 "Light is like mind. Because it shines and goes out. "*
Mathematics	Infinity sign	1	*S22 "Light is like infinity sign. Because when you shine a light in a straight unobstructed direction, it goes to infinity."*
	Variable	1	*S194 "Light is like variable. Because there are different types of light."*
	Straight rope	1	*S195 "Light is like straight rope. Because it spreads linearly."*
Food	Water	4	*S110 "Light is like water. Because it spreads everywhere unless it is stopped. "*
Place	Wall	1	*S206 "Light is like wall. Because when it catches our eye, we can't move forward."*
Total	62	159	

When Table 6 shows, the metaphors developed by gifted students for the concept of "matter" are collected in thirteen categories. These categories are: The categories of light source, scientific knowledge, on life, technology, human, required to see, sky, item, living things, emotion, mathematics, food and place. When Table 6 is examined, the most developed metaphors of the concept of "matter" are: There have been metaphors for the sun (f=36), eye (f=9), information (f=7), and sound (f=7).

Findings related to the Fifth Problem of the Research

The metaphors developed by gifted students for the concept of "Sound", the categories of metaphors and the findings obtained from metaphor examples are shown in Table 7.

Table 7

Metaphors for the concept of the sound, its categories and sample metaphors

Categories	Metaphors	Frequency	Sample metaphors
	Wave	32	*S51 "Sound is like waves. Because it spreads like a wave and comes to our ears."*
	Microphone	7	*S43 "Sound is like microphone. Because the microphone makes the volume high."*

Sound source	Phone	6	*S34 "Sound is like phone. Because we can't communicate without both."*
	People	5	*S77 "Sound is like people. Because people make a lot of noise."*
	Noise	4	*S141 "Sound is like noise. Because it's very loud."*
	Loudspeaker	3	*S72 "Sound is like loudspeaker. Because it makes the sound louder."*
	Musical instrument	3	*S118 "Sound is like musical instrument. Because musical instruments make beautiful sounds."*
	Bird	2	*S46 "Sound is like bird. Because it's going by air."*
	Wind	2	*S155 "Sound is like wind. Because the sound comes and goes like the wind."*
	A stone thrown into the water	2	*S133 "Sound is like a stone thrown into water. Because it spreads like waves."*
	Human being	1	*S77 "Sound is like human being. Because people make a lot of noise."*
	Radio	1	*S187 "Sound is like radio. Because it gives a voice."*
	Alarm	1	*S120 "Sound is like alarm. Because sounds warn us like alarms."*
	Bee	1	*S73 "Sound is like bee. Because you need a tongue to make a sound and a bee to eat honey."*
	Alarm clock	1	*S198 "Sound is like alarm clock. Because the alarm clock also makes a sound."*
	Hammer	1	*S99 "Sound is like hammer. Because we can break glass with a hammer, if our sound is the same as the frequency of glass, we can break glass. "*
	Horn	1	*S131 "Sound is like horn. Because the horn is also a sound."*
	Radar	1	*S33 "Sound is like radar. Because the sound spreads in a circular way, the radar scans in a circular way."*
	Clock	1	*S161 "Sound is like clock. Because there is sound from the clock."*
	Song	1	*S78 "Sound is like song. Because it's done with sound."*
	Piano	1	*S122 "Sound is like piano. Because piano is also a source of sound."*
Nature	Water	8	*S137 "Sound is like water. Because water fluctuates, sound is in waves."*
	Sea	7	*S167 "Sound is like sea. Because sound spreads in waves, there are waves in the sea."*
	Light	7	*S173 "Sound is like light. Because they both spread."*
	Mountains	1	*S140 "Sound is like mountains. Because some are high and some are low."*

	World	1	*S172 "Sound is like world. Because it moves."*
	Universe	1	*S119 "Sound is like universe. Because there are voices of many beings."*
	Pollution	1	*S176 "Sound is like pollution. Because there's a lot of noise pollution."*
	Emotion	3	*S14 "Sound is like emotion. Because it is one of the most important ways for us to express ourselves."*
	Colour	2	*S177 "Sound is like colour. Because it colors life."*
	Life	2	*S130 "Sound is like life. Because we can't spend life in silence."*
	Appearance	1	*S44 "Sound is like appearance. Because the voice reflects one's style."*
	Knowledge	1	*S7 "Sound is like knowledge. Because it informs us."*
	Education	1	*S201 "Sound is like education. Because sound is as essential as education."*
	Entertainment	1	*S23 "Sound is like entertainment. Because we can have fun talking, we sing."*
	Unique	1	*S68 "Sound is like unique. Because nothing will be able to make that sound."*
	Someone invisible	1	*S152 "Sound is like someone invisible. Because it is heard but not seen."*
	Smile	1	*S87 "Sound is like smile. Because it makes you happy and calms you down."*
	Ring	1	*S17 "Sound is like ring. Because sound spreads in waves."*
	The man running in the air	1	*S146 "Sound is like a man running in the air. Because it's going in the air."*
	Smell	1	*S45 "Sound is like smell. Because it's invisible."*
	Massage	1	*S8 "Sound is like massage. Because it relaxes our brains and souls."*
	Fashion	1	*S49 "Sound is like fashion. Because it can always change."*
Emotion	Being neglected	1	*S91 "Sound is like being neglected. Because if no one hears your voice, you'll know you're neglected."*
	Love	1	*S67 "Sound is like love. Because it's not seen, but it's felt."*
	Secret	1	*S110 "Sound is like secret. Because we can't hear some voices, and we can't know some secrets about us."*
	Abstract	1	*S144 "Sound is like abstract. Because they are both intangible."*
	Feather	1	*S100 "Sound is like feather. Because they both spread."*
	Writing	1	*S64 "Sound is like writing. Because they both say so much."*
	Hear	3	*S38 "Sound is like hearing. Because voices are*

			heard. "
Required for sound	Air	2	*S42 "Sound is like air. Because we can't see either of them."*
	Talk	2	*S116 "Sound is like talking. Because we make a sound by talking."*
	Mouth	1	*S136 "Sound is like mouth. Because it provides communication."*
	Our tongue	1	*S27 "Sound is like our tongue. Because we talk with it."*
	Ear	1	*S59 "Sound is like ear. Because the ear allows us to hear sound."*
	Vibration	1	*S194 "Sound is like vibration. Because sound is produced by vibration."*
Item	Mirror	2	*S89 "Sound is like mirror. Because it is reflected."*
	Drill	2	*S123 "Sound is like drill. Because drill is also a source of sound."*
	Car	1	*S124 "Sound is like car. Because they both make noise."*
	Pen	1	*S94 "Sound is like pen. Because when we write, we tell something, and the sounds tell us something."*
	Recorder	1	*S109 "Sound is like recorder. Because people hear us and sometimes, they keep them in their brains."*
Communication	The crown jewel of communication	1	*S10 "Sound is like the crown jewel of communication. Because without sound, it's very difficult to communicate with someone."*
	Phone	1	*S93 "Sound is like phone. Because it provides communication."*
	Communication	1	*S29 "Sound is like communication. Because we communicate via sound."*
	News	1	*S169 "Sound is like news. Because the more information it comes, the more it comes with sound or writing."*
Sky	Sun	3	*S88 "Sound is like sun. Because sometimes we get uncomfortable, sometimes we love."*
Place	City	1	*S166 "Sound is like city. Because it's everywhere."*
	Border	1	*S28 "Sound is like border. Because not everyone can hear everything."*
Total	69	156	

When Table 7 shows, the metaphors developed by gifted students for the concept of "Sound" are collected in eight categories. These categories are: The source of sound is nature, emotion, required for sound, item, communication, sky and place categories. When Table 7 is examined, the most developed metaphors of the concept of "sound" are: Wave (f=32), water (f=8), microphone (f=7), sea (f=7), light (f=7), telephone (f=6), human (f=5) and noise (f=4).

Findings related to the Sixth Problem of the Research

The metaphors developed by gifted students for the concept of "Electricity", the categories of metaphors and the findings obtained from metaphor examples are shown in Table 8.

Table 8

Metaphors for the concept of the electricity, its categories and sample metaphors

Categories	Metaphors	Frequency	Sample metaphors
Necessary for life	Water	16	*S3 "Electricity is like water. Because water is necessary for living things to live and electricity is necessary for items to work."*
	Light	10	*S100 "Electricity is like light. Because they both radiate."*
	Oxygen	5	*S5 "Electricity is like oxygen. Because without electricity, the devices won't work."*
	Energy	4	*S65 "Electricity is like energy. Because thanks to electricity, we can run our electronics because electricity is a source of power."*
	Heart	4	*S29 "Electricity is like heart. Because without electricity, life stops."*
	Brain	3	*S204 "Electricity is like brain. Because everything depends on it, control makes power real."*
Emotion	Life	15	*S1 "Electricity is like life. Because electricity is found everywhere in our daily lives."*
	Everything	3	*S92 "Electricity is like everything. Because without electricity, life would be very difficult."*
	Fear	1	*S140 "Electricity is like fear. Because it can make you tremble."*
	Love	1	*S47 "Electricity is like love. Because too much shocks people, but it is a need."*
	Road	1	*S88 "Electricity is like road. Because it goes from place to place all the time."*
	Auxiliary	1	*S7 "Electricity is like auxiliary. Because if we don't have, we can't do much."*
Natural phenomenon	Lightning	10	*S48 "Electricity is like lightning. Because they both shock."*
	Lightning	7	*S97 "Electricity is like lightning. Because it emits electricity, too."*
	Cold weather	1	*S173 "Electricity is like cold weather. Because electricity makes a person shiver, and cold makes you shiver."*
	Life	6	*S155 "Electricity is like power. Because we can get electricity from air, water and artificial means."*
	Power	2	*S155 "Electricity is like power. Because we can get electricity from air, water and artificial means."*
	Sound	2	*S28 "Electricity is like sound. Because electricity*

			is transmitted like sound."
Important for life	Auxiliary	1	*S7 "Electricity is like auxiliary. Because if we don't have, we can't do much."*
	Success	1	*S91 "Electricity is like success. Because when the electricity went out, we couldn't do our homework, we would be less successful in class."*
	Medications	1	*S82 "Electricity is like medications. Because when our health deteriorates, we understand the value of medicines, and when the electricity goes out, we understand the value of it."*
	Book	1	*S63 "Electricity is like book. Because if not, we won't hear from the world."*
	Health	1	*S152 "Electricity is like health. Because if it doesn't, life becomes harder."*
	Industry	1	*S49 "Electricity is like industry. Because it is the basis of production."*
Technology	Car	3	*S64 "Electricity is like car. Because if you can't control it, it hurts."*
	Computer	3	*S46 "Electricity is like computer. Because it makes our lives so much easier."*
	Internet	3	*S198 "Electricity is like internet. Because they are both electricity."*
	Invention	2	*S4 "Electricity is like invention. Because now we always have electricity in our lives."*
	Power plants	1	*S71 "Electricity is like power plants. Because electricity comes out of power plants."*
	Robot	1	*S127 "Electricity is like robot. Because it does whatever we want."*
	Rocket	1	*S196 "Electricity is like rocket. Because electricity is very fast, like a rocket."*
	Technology	1	*S102 "Electricity is like technology. Because technological things run on electricity."*
Item	Cable	2	*S149 "Electricity is like cable. Because the cable transmits it."*
	Lamp	2	*S78 "Electricity is like lamp. Because the lamps are usually powered by electricity."*
	Antenna	1	*S40 "Electricity is like antenna. Because it can run technological products."*
	Item	1	*S22 "Electricity is like item. Because it works very well and we use it as an item."*
	Attire	1	*S94 "Electricity is like attire. Because people use electricity a lot, and we use clothing throughout the day."*
	Battery	1	*S15 "Electricity is like battery. Because it is a stored source of electricity."*
	Wire	1	*S139 "Electricity is like wire. Because it goes through the wire."*
	Ball	1	*S206 "Electricity is like ball. Because it shocks (hits) too."*
	Hedgehog	2	*S120 "Electricity is like hedgehog. Because when*

			a person is electrocuted, there are thorns, and the hedgehog has thorns."
Living thing	Dog	1	*S129 "Electricity is like dog. Because it's dangerous."*
	Mosquito	1	*S26 "Electricity is like mosquito. Because if we touch it, it will harm us."*
	Worm	1	*S145 "Electricity is like worm. Because it goes through the wire."*
	Eel	1	*S95 "Electricity is like eel. Because the eel emits electricity."*
	Running animal	1	*S8 "Electricity is like running animal.* Because they're both very fast."
Human	Runner	1	*S8 "Electricity is like runner. Because they're both very fast."*
	Mother	1	*S108 "Electricity is like mother. Because we can't really do anything without it."*
	Friend	1	*S44 "Electricity is like friend. Because without it we will always be halfway."*
	Assistant	1	*S169 "Electricity is like assistant. Because for most things, electricity helps us."*
	Wizard	1	*S58 "Electricity is like wizard. Because electricity is the magician of the technological tools in our lives."*
Sky	Sun	3	*S6 "Electricity is like sun. Because we can heat up with electricity."*
	Air	1	*S89 "Electricity is like air. Because it's invisible, but it shocks."*
	Star	1	*S187 "Electricity is like star. Because it can flash."*
Food	Food	1	*S9 "Electricity is like food. Because it's indispensable."*
	Lemon	1	*S123 "Electricity is like lemon. Because electricity can be produced from lemons."*
	Sugar	1	*S126 "Electricity is like sugar. Because it makes people happy and gives them energy, but there are also harms."*
	Meal	1	*S93 "Electricity is like meal. Because human being needs both food and electricity."*
Danger	Cross	1	*S125 "Electricity is like cross. Because it can shock us."*
	Unlimited power	1	*S155 "Electricity is like unlimited power. Because we can get electricity from air water and artificial means."*
	Cliff	1	*S203 "Electricity is like cliff.* Because they're both quite dangerous."
Natural resource	Stream	2	*S30 "Electricity is like stream. Because electricity flows like a stream."*
Transmission	Dominoes	1	*S174 "Electricity is like dominoes. Because when the light button is pressed, it can reach all over the house."*

Place	Home	1	*S17 "Electricity is like home. Because if it wasn't, our lives would be hard."*
Total	64	151	

When Table 8 shows, the metaphors developed by gifted students for the concept of "electricity" are collected in fourteen categories. These categories are: Necessary for life, emotion, natural phenomenon, important for life, technology, item, living things, human, sky, food, danger, natural resource, transmission and place categories. When Table 8 is examined, the most developed metaphors of the concept of "electricity" are: Water (f=16), life (f=15), light (f=10), lightning (f=10), lightning (f=7), life (f=6), oxygen (f=5), energy (f=4), and heart (f=4).

Findings related to the Seventh Problem of the Research

The metaphors developed by gifted students for the concept of "Environment", the categories of metaphors and the findings obtained from metaphor examples are shown in Table 9.

Table 9

Metaphors for the concept of the environment, its categories and sample metaphors

Categories	Metaphors	Frequency	Sample metaphors
Place	Home	16	*S39 "Environment is like home. Because if we take good care of it, our future will be so livable."*
	Nature	7	*S178 "Environment is like nature. Because there's nature everywhere in the environment."*
	Forest	7	*S32 "Environment is like forest. Because they both have trees."*
	World	6	*S162 "Environment is like world. Because they both have trees."*
	Universe	4	*S139 "Environment is like universe. Because it's too big."*
	Dump	3	*S192 "Environment is like dump. Because that's how people use the environment, and that's what I liken it to."*
	Building	2	*S86 "Environment is like building. Because you do what you want, it's up to you whether you hurt it or not."*
	Laboratory	1	*S8 "Environment is like laboratory. Because all kinds of discoveries can be made."*
	Shopping mall	1	*S167 "The environment is like a shopping mall. Because there's something different everywhere, and there's a different item in every aisle in the mall."*
	Space	1	*S125 "Environment is like space. Because it's too large."*
	Earth's crust	1	*S103 "Environment is like Earth's crust. Because we can walk on both and we can touch both."*
	Sky	1	*S179 "Environment is like sky. Because it's as big*

			around us as the sky."
Emotion	Life	4	*S160 "Environment is like life. Because everything we need is all around us."*
	Void	2	*S105 "Environment is like void. Because the streets seem to have no end."*
	Life	2	*S88 "Environment is like life. Because it's everywhere in life."*
	Happiness	2	*S117 "Environment is like happiness. Because a clean environment gives happiness."*
	Infinity	2	*S199 "Environment is like infinity. Because the environment is so big."*
	Our senses	1	*S38 "Environment is like our senses. Because we see our environment, smell them, taste them, and hear our environment."*
	Stranger	1	*S68 "Environment is like stranger. Because you're a stranger in a new environment."*
	Rainbow	1	*S89 "Environment is like rainbow. Because it is colorful and peaceful."*
	Colour	1	*S87 "Environment is like colour. Because our environment is full of colors."*
Living thing	Tree	6	*S108 "Environment is like tree. Because without the trees, we cannot breathe, and without the environment we cannot live."*
	Animal	2	*S42 "Environment is like animal. Because animals are part of our environment and make up nature."*
	Plant	1	*S109 "Environment is like plant. Because there are many different plants in the environment."*
Human	Human body	2	*S31 "Environment is like human body. Because it can be damaged and destroyed."*
	Family	2	*S19 "Environment is like family. Because the beings in it are similar to each other."*
	Human being	2	*S136 "Environment is like human being. Because it's varied."*
	Father	1	*S46 "Environment is like father. Because it offers all its possibilities to meet our needs."*
	Mother	1	*S79 "Environment is like mother. Because we can't exist without it."*
	Child	1	*S52 "Environment is like child. Because it needs attention like a child."*
	Baby	1	*S58 "Environment is like baby. Because just as a baby is protected and raised, the environment requires the same care and attention as it does."*
Item	Rubbish bin	3	*S17 "Environment is like rubbish bin. Because people throw their garbage into the environment."*
	Window	2	*S193 "Environment is like window. Because you see everything in the environment."*
	Tray	1	*S24 "Environment is like tray. Because it carries us all."*
	Painting	1	*S9 "Environment is like painting. Because it contains all the landscape paintings."*

Technology	Wind turbines	1	*S5 "Environment is like wind turbines. Because the plants in the environment produce oxygen, and the wind turbines produce electricity."*
	Clock mechanism	1	*S67 "Environment is like clock mechanism. Because many components are interconnected."*
Food	Water	1	*S25 "Environment is like water. Because we need the environment as much as water to live."*
	Pepper	1	*S34 "Environment is like pepper. Because there is such a diverse environment, just like pepper."*
	Lettuce	1	*S207 "Environment is like lettuce. Because the environment is lush."*
Geometry	Shape	1	*S56 "Environment is like shape. Because the environment of everything forms a shape."*
Total	41	98	

When Table 9 shows, the metaphors developed by gifted students for the concept of "environment" are collected in eight categories. These categories are: Space, emotion, living things, human, item, technology, food and geometry. When Table 9 is examined, the most developed metaphors of the concept of "environment" are: Home (f=16), nature (f=7), forest (f=7), earth (f=6), tree (f=6) and life (f=4).

DISCUSSION

In this research, which aims to determine the metaphorical perceptions of gifted students towards basic science concepts, students explained the concept of "universe" with the metaphor of 'infinity' the most. When the metaphorical sentence completions of the students containing their descriptions of the universe were examined, there were more students who focused on the expansion and infinity of the universe. Astronomers have reported that the universe is constantly expanding (Li et al., 2020). Similar results have been found in the studies carried out to determine the perceptions towards the concept of the universe in the literature. In the study of Uluay (2020) on the concept of 'universe', pre-service teachers of science focus most on the metaphor of 'infinity'. After the metaphor of eternity, the metaphor that students used the most was the metaphor of 'darkness'. Scientists have reported that the structure of the universe consists of 69% dark energy and 26% dark matter (Arnaud et al., 2016).

Gifted students explained the concept of "living thing" mostly with the metaphors of 'robot, human, animal, plant and pen'. In the study, gifted students used inanimate metaphors while explaining the concept of living thing. Similarly, in the study conducted by Dinçer & Erdemir (2020), students used inanimate metaphors when explaining the concept of living. In the study, the second dominant category was the 'kinds of living thing' category. In Dinçer & Erdemir's (2020) metaphor study on the concept of life, people, animals and plants were effective in examining the metaphors for 8th grade students to perceive the concept of 'living thing' and in the students' metaphors for the concept of life. When the metaphors produced by the students for the concept of living thing are examined,

the achievements of 'distinguishing between living and inanimate beings, classifying them as plants and animals for living things, and giving examples to living and inanimate beings' in the 'Science course curriculum' were effective. Some students have used inanimate beings as a metaphor for life because of their movement. In the literature, the main element of students' depiction of the concept of living thing is movement (Opfer, 2002; Topsakal, 2009). Another remarkable result of the study was that the students explained the concept of living thing with the metaphor of 'robot'. When the explanations of the gifted students about the robot metaphor were examined, robots thought that they had the characteristics of living things.

Gifted students explained the concept of "matter" most with the metaphors of "water, human, air, everything and item". In Akçay's (2010) study, students used 'water molecules' in their explanations for the change of state of matter. The reason for this is that while the subject of matter is explained in science lessons, it is always shown that water is given as an example, especially in state changes. When the metaphors produced by gifted students about the concept of matter are examined, the vast majority of them generally use metaphors that show macro characteristics such as 'item, toys, food, space, living thing and nature'. A small number of students used metaphors with micro-properties such as 'cell, atom, nucleus, drop and seed' to explain the concept of matter. This result may be due to the fact that the granular structure of the substance is included in the Science curriculum after the 7th grade. There are similar results in some studies on the concept of matter in the literature. In the study of Nakhleh & Samarapungavan (1999), students used macro properties when defining the concept of matter. In Özmen's (2002) study, it was concluded that 4th, 5th and 6th grade students had very low levels of knowledge about the microscopic properties of matter. In Akçay's (2010) study, students generally think about the concept of 'matter' in the macro dimension, but some of the 8th grade students think in the micro dimension. In the studies of Dönüş Coşgun & Karamustafaoğlu (2017), a large part of the students explained the concept of matter by using the examples of 'stone, table, wood and pencil' from solid substances, 'water, milk and fruit juice' from liquid substances and 'air and gas' from gaseous substances. When the metaphor categories produced by the students with special abilities for the concept of matter are examined, the achievements of 'defines the substance, classifies the substance, the properties that characterize the matter, the states of matter, the measurable properties of matter, the granular structure of matter' in the 'Science course curriculum' are effective.

The metaphor that gifted students developed the most for the concept of "light" was the metaphor of "sun". When the studies on the concept of light in the literature were examined, the metaphor of the sun was the most developed metaphor by the students (Aygün et al., 2015; Değirmeci et al., 2019; Demirci, 2020). Students explained the concept of light with metaphors appropriate to the subject of 'natural light sources, artificial light sources' in the 'Science course curriculum'. Students used metaphors such as 'vision, sound, electricity, heat and energy' which are among the concepts of science to explain the concept

of light. This result revealed that students with special abilities used other scientific concepts to explain a scientific concept. There are studies in the literature that support this result. In the study conducted by Değirmenci et al. (2019) in order to reveal the metaphorical perceptions of theology and science teaching students towards the concept of light, it was concluded that pre-service teachers of science use scientific concepts when the metaphors they produce for the concept of light are examined. Similarly, in the study conducted by Aygün et al. (2015) in order to determine the perceptions of science and primary school pre-service teachers of mathematics towards the concept of light, pre-service teachers of science produced metaphors with more scientific content. The metaphors and explanations produced by the students show that they have grasped the subject of light and vision in the Science curriculum.

The metaphors that gifted students developed the most for the concept of "electricity" were 'water, life, light and lightning'. The category with the most metaphors was the 'necessary for life' category. In the category of necessary for life, students explained the concept of electricity with metaphors appropriate to the subject 'explains the importance of electricity in daily life' in the 'Science curriculum'. Similarly, in the study of Demirci (2020), the categories in which pre-service teachers produced the most metaphors for the concept of electricity were 'important for life' and 'necessary for life'. In the study of Kurt & Sarı (2018), the metaphors produced by physics pre-service teachers of physics about electricity had characteristics belonging to 'object, person and abstract concepts'.

The metaphors that gifted students developed the most for the concept of "environment" were 'house, nature, forest, world, universe and tree'. In the study of Aydın (2013), the metaphors that students produced the most for the concept of environment were 'life, our home and living'. In Doğan's (2017) study, the metaphors that secondary school students produced the most about the concept of environment were 'life, our home, people, mother and garbage'. In the study of Yanarateş & Yılmaz (2020), the metaphor that pre-service teachers produced the most for the concept of environmental sensitivity was the metaphor of 'clean house'. In the study of Meral et al. (2016), pre-service teachers used the metaphors of 'human, teacher, home, life, family and mother' mostly related to the concept of environment. In the study, students produced various metaphors related to the concept of environment by using the concepts of living and inanimate. In the literature, living things have two environments, 'living and inanimate' (Yıldırım & Genç 2005; Aslan & Dinç 2007; Görür 2011; Kocataş 2012). In the study, the concept of environment was classified in 8 different categories. The category with the most metaphors was the 'place' category. Çepel (2006) defines the concept of environment as the environment in which living things live. In addition, in the categories of 'human, place and technology', students explained the concept of environment with metaphors appropriate to 'people, places and environments' and 'science, technology and society' in the 'Science course curriculum'. In the study, gifted students produced a limited number of metaphors for the concept of 'environment' compared to other basic science concepts. Some studies conducted to determine student

perceptions of the concept of environment in the literature support this conclusion (Doğan, 2017; Çakmak, 2018).

LIMITATIONS AND RECOMMENDATIONS

The study's findings show that metaphors can be used as a powerful tool to reveal the personal thoughts of gifted students about science concepts. Further research can be conducted to analyze students' perceptions of science concepts at different grade levels in different samples through metaphors. Metaphoric techniques can be used to make sense of concepts in the mind and establish relationships between concepts. In measurement and evaluation processes, metaphors can be used to reveal mislearning. Students can use the knowledge they have in different courses through metaphors by establishing interdisciplinary connections. Developing metaphors with science concepts can help students grow up as science-literate individuals. By increasing the number of study groups, the scope of the research can be expanded, and more data can be obtained.

CONCLUSION

The metaphor study concluded that gifted students have a very broad level of thinking about basic science concepts. When the tables for each concept were analyzed separately, it was seen that the selected concepts formed a rich cognitive structure, and a vast metaphor network was formed thanks to the diversity in definitions. In the study, it was noticed that gifted students tried to establish a connection between the metaphors they produced and their daily lives and tried to transfer the concepts to people, objects, or situations in their lives. This inference aligns with the philosophy of the science teaching program, which is to make knowledge meaningful and experiential for the individual. Knowing the metaphors of gifted students is valuable for teachers and essential in increasing their lessons' efficiency. Only in this way can teaching methods and new curricula be developed in science courses.

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Data Availability Declaration

The data can be shared upon request.

Author Contributions

Multiple Authors with Equal Contribution:

Author Contributions:

All authors, Tuba DEMİRCİ and Gamze KOCABAŞ contributed equally to this work. They collaboratively handled the conceptualization, methodology design, data acquisition, and analysis. Each author played a significant role in drafting and revising the manuscript, ensuring its intellectual depth and coherence. All authors have thoroughly reviewed, provided critical feedback, and approved the final version of the manuscript. They jointly take responsibility for the accuracy and integrity of the research.

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