Journal of Culture, Society and Communication, 1(1), 7-21, 2025
DOI: 10.5281/zenodo.15974693

JCSC Journal of Culture, Society and Communication journalcsc.com

Journal of Culture, Society and Communication journalcsc.com cultureandsocietyjournal.com

Founded: 2025 *Available Online* ISSN: 3108-3897

Pre-Service Teachers' Perceptions of the Concept of Mathematics: A Metaphor Analysis

Gökhan DEMİRCİOĞLU[1] Eda Nur ÖZTÜRK[2] İrem Naz BEKTAŞ[3]

[1] Prof. Dr., Trabzon University, gdemir@trabzon.edu.tr

[2] Independent Researcher, edanur_ozturk22@trabzon.edu.tr

[3] Independent Researcher, iremnaz_bektas21@trabzon.edu.tr

Article Type

Research Article

History

Received: 02.06.2025
Accepted: 14.07.2025
Published: 15.07.2025

ABSTRACT

This research aimed to determine how pre-service teachers perceive the concept of "mathematics." A total of 286 participants from eight different teaching programs participated in the research. The study employed a phenomenological method based on a qualitative research approach. Data in the present study were collected by asking pre-service teachers to complete the statement: "Mathematics is like ..... Because .....". After data collection, the metaphorical expressions were analyzed using a holistic approach. According to the findings, the most frequently repeated metaphor was "life." Following the "life" metaphor, the most commonly repeated metaphors were "water" and "puzzle." The metaphors generated by pre-service teachers were grouped into ten categories. The most prominent category was "positive or negative emotions." Metaphors of English, preschool, special education and classroom teacher candidates were predominantly associated with the "positive or negative emotions" category. Pre-service mathematics teachers were concentrated in the 'cumulative, evolving, and changing' category, while pre-service primary mathematics teachers emphasized the "field needed in daily life" category. Pre-service science teachers were primarily associated with the 'versatile field' category. Similar studies should be conducted with pre-service teachers from different universities to compare perceptions of mathematics across institutions.

Keyworld: Mathematics, Teacher education, Metaphor.

Öğretmen Adaylarının Matematik Kavramına Yönelik Algıları: Bir Metafor Analizi

Makale Türü

Araştırma Makalesi

Süreç

Gönderim: 02.06.2025
Kabul: 14.07.2025
Yayın: 15.07.2015

ÖZET

Bu araştırma, öğretmen adaylarının "matematik" kavramını nasıl algıladıklarını belirlemeyi amaçlamaktadır. Araştırmaya yedi farklı öğretmenlik programından toplam 286 kişi katılmıştır. Çalışmada nitel araştırma yaklaşımına dayalı fenomenolojik yöntem kullanılmıştır. Çalışmada veriler, öğretmen adaylarından "Matematik……gibidir. Çünkü……" ifadesini tamamlamaları istenerek toplanmıştır. Veriler toplandıktan sonra metafor cümleleri bütüncül bir yaklaşım kullanılarak analiz edilmiştir. Elde edilen bulgulara göre en sık tekrarlanan metafor "hayat" metaforu olmuştur. "Hayat" metaforundan sonra en çok tekrar eden metaforlar ise "su" ve "bulmaca" olmuştur. Öğretmen adaylarının ürettiği metaforlar toplam 10 kategori altında toplanmıştır. En çok öne çıkan kategori "pozitif veya negatif duygular" kategorisidir. İngilizce, okul öncesi, özel eğitim ve sınıf öğretmeni adaylarının metaforları baskın bir şekilde "pozitif veya negatif duygular" kategorisi ile ilişkilendirilmiştir. Matematik öğretmeni adayları "birikimli, değişen ve gelişen" kategorisinde, ilköğretim matematik öğretmeni adayları "günlük hayatta ihtiyaç duyulan bir alan" kategorisinde ve fen bilgisi öğretmeni adayları ise "çok boyutlu bir alan" kategorisinde yoğunluk göstermektedirler. Benzer çalışmaların farklı üniversitelerdeki öğretmen adayları ile yürütülerek kurumlar arası matematik algılarının karşılaştırılması sağlanabilir.

Anahtar Kelimeler: Matematik, Öğretmen eğitimi, Metafor

Demircioğlu, G., Öztürk, E. N., & Bektaş, İ. N. (2025). **Pre-Service Teachers' Perceptions of the Concept of Mathematics: A Metaphor Analysis**, *Journal of Culture, Society and Communication, 1*(1), 7-21. DOI: 10.5281/zenodo.15974693.

Introduction

In today's societies, it is aimed to increase the number of individuals who have 21st century skills (such as problem solving, creativity, collaboration, critical thinking, entrepreneurship). In order to develop problem-solving skills, the individual's mathematical thinking skills must first be developed. In this way, individuals can understand the cause and effect relationship in an event and reach systematic solutions. Mathematical thinking is an important building block in mathematics education. Based on these thoughts, four general goals of mathematics education in schools have been determined as "valuing mathematics, gaining mathematical thinking skills, using mathematics as a means of communication, and gaining problem-solving skills" (Baki, 2020). These four basic purposes must be acquired by the student. Teachers are the ones who will guide students in gaining these skills. Therefore, the teacher's attitude towards mathematics significantly affects the attitude of students. If a teacher has negative feelings towards mathematics, they will also convey negative attitudes and thoughts towards mathematics to their students and will not be able to make them love mathematics. Therefore, students of a teacher with a negative attitude cannot be expected to be successful in mathematics (Çalışıcı and Sümen, 2019). It is claimed that the more positive attitudes students develop towards mathematics, the more successful they are (Ersan and Aktan, 2024; Demirkıran et al., 2023; Saatçioğlu, 2023; Taşkın et al., 2024). Teachers should make an effort to ensure that students develop positive judgments and attitudes and to make them love mathematics, considering that their attitudes and judgments towards mathematics affect their students in the same way (Şahin, 2013). Knowing the attitudes, interests and beliefs of prospective mathematics teachers towards mathematics is an important factor in their professional development. Therefore, it is important to determine the attitudes and perceptions of prospective mathematics teachers and prospective teachers from other branches who will use mathematics in their courses (Filiz, 2018). One of the methods used to determine how prospective teachers perceive mathematics and their attitudes towards mathematics is metaphor analysis (Şahin, 2013).

Metaphor is derived from the Greek word "metaphora". The term 'metaphor' was explained using familiar terms during its adoption into Turkish and subsequently defined within the language's grammatical rules. While metaphor means simile in the Turkish dictionary (TDK, 2015), it is explained with the meanings of metaphor, allegory and simile in many other dictionaries (Doğan, 1999; Saraç, 1999). Metaphors have been studied across numerous disciplines, including philosophy, mathematics, science, and psychology. The word metaphor has many definitions. Some of these definitions are as follows. Güveli (2011) defines metaphor as a means of transfer from the known to the unknown. Saban et al. (2017) explain metaphor as a mental tool that affects our thoughts in an event situation. Metaphors, in their most general sense, are associating a concept with another concept, outside of its literal meaning, by using similarities (Semerci, 2007). Metaphors can be defined as the art of likening abstract concepts to concrete facts, events and objects. Metaphor consists of three basic elements: the subject of the metaphor, the source of the metaphor, and the characteristics associated with the subject of the metaphor from the source of the metaphor (Şahan, 2017). For example, in the sentence "Mathematics is like a calculator," the source of the metaphor is a calculator, the subject is mathematics, and the thought that is related from the source of the metaphor to the subject of the metaphor is "Mathematics is like a calculator." Because mathematics is a tool for doing practical operations, like a calculator.

The reason why it is frequently preferred in the field of education is to determine people's mental perceptions about a concept, subject or event. Examples of metaphor analysis in our country: primary school students' "teacher" (Ertürk, 2017), fourth grade students' "mathematics problem solving" (Can, 2021), middle school students' "environment" (Doğan, 2017), 8th grade students' "new generation question" (Şad and Aydın, 2023), high school students' "philosophy" (Ünsal et al., 2016), and "infinity" (Habacı and Çetin, 2023), middle and high school students' "Science" (Bıyıklı et al., 2014), university students' "cultural heritage" (Sarı et al., 2020), "dance" (Ayyıldız, 2016), "Turkish education system" through the eyes of academicians and teachers (Saylık et al., 2021), teacher candidates' "communication" (Demircioğlu, 2023), "value" (Sulak and Aydın, 2015), "distance education" of students, teachers and parents (Karakuş and Karacaoğlu, 2021), "technology leadership" of school administrators (Hacıfazlıoğlu et al., 2011), "postgraduate education" of graduate students (Polat et al., 2022). As can be seen, the examples in the literature vary according to primary school, secondary school, high school, university, graduate school, academician and stakeholders in education.

There are many studies examining the metaphorical perceptions of prospective teachers in different programs regarding mathematics and mathematical concepts. In one of these studies, Güveli et al. (2011) examined the metaphorical perceptions of prospective teachers regarding the concept of mathematics and determined conceptual categories as "mathematics is an exciting course, a difficult and boring course, and a course consisting of many

topics". In another study, the perceptions of prospective teachers studying in different programs of Muğla University Faculty of Education towards mathematics teachers, mathematics and mathematics lessons were investigated according to their experiences in primary and high school (Şahin, 2013). According to the results obtained, the concept of mathematics teacher was most associated with the metaphors of "authoritarian" and "knowledgeable", the concept of mathematics was most associated with the metaphors of "enjoyable", "intelligence", "talent" and "difficult", and the mathematics Course was most associated with the metaphors of "Successful".

There are also studies examining prospective mathematics teachers' perceptions of mathematical metaphors. In their research, Çalışıcı and Sümen (2019) identified 80 metaphors about mathematics and grouped them under 11 conceptual categories. On the other hand, they revealed that prospective teachers mostly represented mathematics with the metaphor of "life". While female prospective teachers and primary school mathematics teacher candidates expressed mathematics mostly in the conceptual category of "a needed area in daily life", male prospective teachers expressed mathematics as "an area that is enjoyed to deal with" and secondary school mathematics teacher candidates expressed mathematics in the conceptual category of "a demanding field". Moralı et al. (2022) examined the metaphorical perceptions of prospective mathematics teachers regarding the nature of mathematics in the dimensions of "platonist, instrumentalist and problem solving". It was determined that prospective teachers were most in the problem solving dimension and least in the instrumentalist dimension. Güler et al. (2012) examined the metaphor perceptions of prospective secondary school mathematics teachers regarding the concept of mathematics by dividing them into five categories. These categories are "need, guide, infinity, perspective and life itself". In this study, the category "life itself" was preferred the most

When academic studies are examined, it has been determined that the positive and negative meanings that prospective mathematics teachers attribute to the concept of mathematics affect students' attitudes towards mathematics. Therefore, the metaphorical perceptions of prospective teachers regarding the concept of mathematics are the starting point of this study.

In this direction, the main problem of the research was determined as "How do prospective teachers from different branches studying at Trabzon University perceive the concept of "mathematics?" The following sub-problems were investigated within the framework of the main problem of the research.

- *What are the metaphors that prospective teachers have regarding the concept of mathematics?*
- *Under which conceptual categories can the metaphors of prospective teachers regarding the concept of mathematics be gathered?*

Purpose of the Research

The aim of this research is to reveal the perceptions of prospective teachers regarding the concept of mathematics through the metaphors they produce and to investigate under which categories these metaphors can be gathered.

Research Method

In the study, a phenomenological research method based on a qualitative research approach was used. The phenomenological research method is an important method for determining individuals' experiences of an event and how they make sense of these experiences. It is used to determine what a phenomenon means to individuals, what their experiences are regarding the phenomenon, and their common thoughts about the phenomenon (Çapar and Ceylan, 2022). In other words, it is one of the methods used to determine perceptions of phenomena or events. Phenomenology focuses on phenomena that we are aware of but cannot explain in depth. Phenomenology studies aim to interpret individuals' perceptions of a phenomenon (Yıldırım and Şimşek, 2008). Phenomenology is widely used because it allows us to make inferences about abstract topics and allows us to understand complex structures more easily (Demircioğlu, 2023; Güneş and Fırat, 2016).

In this study, metaphor analysis will be used to determine how prospective teachers make sense of their experiences related to the concept of mathematics. For this purpose, phenomenological research and metaphor analysis are interrelated and mutually supporting processes (Demircioğlu, 2023).

Research Group

A total of 286 prospective teachers studying in different departments and classes of Trabzon University Fatih Faculty of Education in the 2024-2025 spring academic year participated in this study. Demographic information of the teacher candidates participating in the study is shown in Table 1.

Table 1 shows that the number of teacher candidates participating in the study varies between 30 and 49 according to departments. A total of 286 teacher candidates participated in the study, 112 of whom were male and 174 were female. Male were indicated with the letter M, Female with the letter F and an appropriate code was created for each participant. Table 3 shows the abbreviations of the departments. For example, BEM2 code indicates basic education, male, and 2nd teacher candidate.

Table 1. Distribution of prospective teachers according to department and gender variables

Departments	Female		Male		Total	
	f	%	f	%	f	%
Elementary Science Education (ESE)	19	11	11	10	30	10
Mathematics Education (ME)	24	14	18	16	42	15
Elementary Maths Education (EME)	27	15	22	20	49	17
Social Sciences Education (SSE)	23	13	9	8	32	11
English Teaching (ET)	17	10	16	14	33	12
Basic Education (BE)	23	13	13	12	36	13
Preschool Teaching (PT)	24	14	9	8	33	12
Special Education (SE)	17	10	14	12	31	11
Total	**174**		**112**		**286**	

Data Collection Tool

When metaphor analysis studies in the literature were examined, it was determined that a similar survey form was generally used to collect data. The form consisted of demographic questions, a sample metaphor sentence, and a sentence pattern with blanks left for participants to complete (Ayyıldız, 2016; Bıyıklı et al., 2014; Demircioğlu, 2023; Saylık et al., 2021; Ünsal et al., 2016). In this study, a data collection tool consisting of two sections was used to determine the metaphors of prospective teachers towards the concept of mathematics. The first part of the data collection tool includes questions regarding demographic characteristics and instructions regarding filling out the form. The second part includes a sample metaphor sentence regarding the concept of mathematics (Mathematics is like a tree. Because it feeds from many different disciplines with its roots. It is divided into many sub-fields with its branches. On the other hand, it contributes to many disciplines.) and a statement that prospective teachers are asked to fill out in the form of "Mathematics is like……. Because…." Before the data collection tool was distributed to the participants, the authors provided information about the concept of metaphor. It took the participants 7-12 minutes to fill out the data collection tool.

Data Analysis

After the data collection process was completed, the analysis of metaphor sentences was carried out by adopting a holistic approach. The resulting metaphors and explanations must be appropriate and valid for the concept of mathematics. For this reason, metaphor sentences with insufficient explanations or those that are not appropriate for the concept of mathematics were excluded from the scope of the study. The identified metaphors were grouped based on the similarity of their explanation parts. From here, 10 categories were obtained: "A versatile field, A demanding field, Cumulative, evolving and changing, Problem solver, A needed area in daily life, Infinite, An orderly-systematic structure, Mathematics as the basis of the universe, Positive or negative emotions and Other". Metaphors were placed into categories by two researchers separately. As a result of this process, the two researchers placed 8 metaphors into different categories. These 8 metaphors placed into different categories were evaluated together by the authors and placed into categories that were decided upon jointly.

Inter-rater reliability method was used for the reliability of the data. Within the scope of this method, participants' metaphors were assigned to categories independently by two raters. After assignment, inter-rater consistency was calculated using the Cohen's Kappa formula. The kappa coefficient was found to be 0.97. If the kappa coefficient is between 0.81 and 1.00, it is said that almost perfect agreement is achieved (Landis and Koch, 1977). From here it can be said that the reliability of the study is very high.

Results

This section includes information on the metaphors created by prospective teachers regarding the concept of mathematics and the conceptual categories created based on these metaphors. The metaphors produced according to the first problem of the research are shown in Figure 1 with a word cloud.

Figure 1. Word cloud of prospective teachers regarding the concept of mathematics

As seen Figure 1, the metaphors "Life", "Water", and "Puzzle" come to the fore in the word cloud of prospective teachers. The metaphors produced by prospective teachers regarding the concept of

mathematics and their frequencies are presented in detail in Table 2.

Table 2. Metaphors Produced by Prospective Teachers Regarding the Concept of Mathematics

No	Metaphors	f	No	Metaphors	f
1	Island map	1	94	Life	30
2	Tree	1	95	Part of life	2
3	Pain	1	96	Wheels of life	1
4	Octopus	1	97	Little piece of life	1
5	Family	1	98	Unsolved problem in life	1
6	Flowing river	1	99	Everything	2
7	Aquarium	1	100	All-encompassing circle	1
8	Aleyna Tilki song	1	101	Nothingness	1
9	Algorithm	3	102	English	1
10	Key	2	103	Human	3
11	Bee	2	104	Human brain	1
12	Beehive	1	105	Swiss army knife	1
13	Love	4	106	Torture	1
14	Atom	2	107	Light	1
15	Father	1	108	Women	1
16	Garden	1	109	Heart	2
17	The handle of the axe	1	110	Cancer	1
18	Step	1	111	Door handle	1
19	To succeed	1	112	Black hole	1
20	Baby's first steps	1	113	Ant house	1
21	Brain	1	114	Mixed road map	1
22	Computer	1	115	A complex structure	1
23	Science center	1	116	Complex and variable	1
24	Riddle	1	117	A lost child	1
25	Building building	1	118	Reading a book	1
26	Foundation of building	1	119	Our girlfriend	2
27	Louse	1	120	A tangled rope	1
28	Never ending road	1	121	User manual	1
29	Empty paper	1	122	Sand grains	1
30	Gap	1	123	A multiple cube	1
31	Kidney	1	124	Labyrinth	5
32	End of episode monster	1	125	Machine	1
33	Washing dishes	1	126	Cosmetics	1
34	Puzzle	7	127	Fruits at the grocery store	1
35	Cloud	1	128	Logical system	1
36	Boomerang	1	129	Stairs	1
37	Big and scary mountain	1	130	Season	1
38	Monster	1	131	Fruit	1
39	Cell phone	1	132	Headman	1
40	Punishment	1	133	An ungrateful person	1
41	Wallet	1	134	Pomegranate	1
42	Bag	1	135	Breath	1
43	Wheel	1	136	River	1
44	Roof	1	137	Oxygen	2
45	Flower	1	138	Ocean	6
46	Flower petals	1	139	Common language	1
47	Raw meatballs	1	140	Game	6
48	Chocolate	1	141	Play dough	1
49	Dead end	1	142	Teacher	1
50	Plane	1	143	Elixir of immortality	1
51	Child	1	144	Paradox	1
52	Multi-Storey Building	1	145	Problem	1
53	Soup	1	146	Real Madrid	1
54	The person you love so much but can't get back together	1	147	Menstruation	1
55	Desert	1	148	Painting	1
56	Mountain	1	149	Art	1
57	Sea	5	150	Spiral	1
58	Grains of sand in the sea	1	151	War	1
59	Language	6	152	Dancing with numbers	1
60	Learn languages	1	153	Playing with numbers	1

61	Gear wheel	1	154	Darling	1
62	Nature	1	155	An acquaintance we don't like	1
63	Wall	1	156	Cigarette	1
64	Knot	1	157	A universe full of secrets and mysteries	1
65	Knot thread	1	158	Endless loop	1
66	World	1	159	Family tree	1
67	Binoculars	1	160	An abstract and imaginary system	1
68	A child who can't get enough of fun	1	161	Water	11
69	A sour gum	1	162	Constantly flowing water	1
70	Old embroidered chest	1	163	Recipe book	2
71	Old darling	1	164	Soil	1
72	Home	1	165	Train	1
73	Housewife	1	166	Train tracks	1
74	Universe	4	167	Tuğba teacher	1
75	Factory	1	168	Passion	1
76	Philosophy	2	169	Space	4
77	Science	1	170	Outer space	1
78	Fenerbahçe	1	171	An indispensable item	1
79	Soccer team	1	172	X	1
80	Skyscraper	1	173	Loneliness	1
81	Rainbow	1	174	Jigsaw	4
82	Sky	2	175	Living	2
83	Rose	1	176	A livable day	1
84	Shadow	2	177	Summer sun	1
85	Magnificent and detailed structure	1	178	Food	2
86	Sun	1	179	Stars	1
87	Solar powered lamp	1	180	Road map	1
88	Loud sound	1	181	Swim	1
89	Map	1	182	Intelligence cube	2
90	Weather	1	183	Mind	1
91	Cool and smart woman	1	184	Chain	2
92	Ghost	1	185	Chain ring	1
93	Disappointment	1			

According to Table 2, prospective teachers explained mathematics with 185 different metaphors. When Table 2 is examined, it is seen that prospective teachers mostly represent mathematics with the metaphor of "life" (30). In the study, the metaphor "water" (11) was used the most after the metaphor "life", and puzzle (7), language (6), ocean (6), game (6), sea (5), labyrinth (5), love (4), universe (4), space (4), jigsaw (4), algorithm (3), human (3), key (2), bee (2), atom (2), philosophy (2), sky (2), shadow (2), part of life (2), everything (2), heart (2), our girlfriend (2), oxygen (2), recipe book (2), living (2), food (2), ıntelligence cube (2), chain (2) were used in descending order. Other metaphors were used once.

Within the framework of the second research problem of the study, the metaphors created by the prospective teachers regarding the concept of mathematics were grouped under 10 conceptual categories. These categories are "a versatile field", "a demanding field", "cumulative, evolving and changing", "problem solver", "a needed area in daily life", "ınfinite", "an orderly and systematic structure", "mathematics as the basis of the universe", "positive or negative emotions" and "other".

286 prospective teachers who participated in the study mostly preferred the categories of "positive or negative emotions" (31%), "a needed area in daily life" (16,4%) and "cumulative, evolving and changing" (12,2%). the least preferred category is "other" (0.7%). In this case, approximately one-third of teacher candidates see mathematics as a field that evokes positive or negative emotions. The percentage distribution of conceptual categories according to the programs in the study is shown in detail in Table 3.

Table 3. Conceptual categories by programs

Conceptual Categories	ESE %	ME %	EME %	SSE %	ET %	BE %	PT %	SE %	Total %
A versatile field	16,7	16,7	14,3	12	3	11	0	3,2	10
A demanding field	10	7	14,3	6,3	9	2,7	12	12,9	9,4
Cumulative, evolving and changing	13,3	23,8	6	9,4	9	11	15	9,7	12,2
Problem solver	10	9,5	6	6,3	6	0	0	3,2	5,2
A needed area in daily life	13,3	12	20,4	15,6	12	28,7	15	12,9	16,4
Infinite	6,7	9,5	4	9,4	3	11	12	3,2	7,3
An orderly and systematic structure	6,7	4,8	10,2	6,3	6	0	0	9,7	5,6
Mathematics as the basis of the universe	3,3	0	4	3	3	0	0	0	1,75
Positive or negative emotions	13,3	16,7	20,4	31,2	48,5	36	45	45,2	31
Other	6,7	0	0	0	0	0	0	0	0,7

ESE: Elementary Science Education, ME: Mathematics Education, EME: Elementary Mathematics Education, SSE: Social Sciences Education, ET: English Teaching, BE: Basic Education, PT: Preschool Teaching. SE: Special Education

In the study, science teacher candidates mostly made metaphorical explanations under the conceptual category of "a versatile field (16,7%)", mathematics teacher candidates under the conceptual category of "cumulative, evolving and changing (23,8%)", primary school mathematics teacher candidates under the conceptual category of "a needed area in daily life (20,4%)" and "positive or negative emotions (20,4%)", and teacher candidates in other programs under the conceptual category of "positive or negative emotions".

Metaphors evaluated in the positive or negative emotions category are given in Table 4. Metaphors of prospective teachers who evaluated mathematics as positive and negative emotions were included in this category.

Table 4. Positive or negative emotions

Metaphors (f=69)	f	%
Life (10), maze (4), sea (4), game (3), puzzle (2), love (2), human (2), unsolved problem in life (1), science (1), problem (1), punishment (1), a tangled rope (1), raw meatballs (1), an acquaintance we don't like (1), a lost child (1), nothingness (1), complex and variable (1), space (1), monster (1), Real Madrid (1), cigarette (1), art (1), a livable day (1), weather (1), chocolate (1), season (1), an ungrateful person (1), a complex structure (1), menstruation (1), boomerang (1), elixir of immortality (1), human brain (1), disappointment (1), door handle (1), sand grains (1), a child who can't get enough of fun (1), headman (1), cancer (1), loneliness (1), paradox (1), binoculars (1), node (1), torture (1), cool and smart woman (1), child (1), an abstract and imaginary system (1), painting (1), playing with numbers (1), father (1), summer sun (1), the person you love so much but can't get back together (1), dead end (1), empty paper (1), loud sound (1), Aleyna Tilki song (1), old darling (1), darling (1), pain (1), ghost (1), mixed road map (1), reading a book (1), rose (1), water (1), louse (1), space (1), Fenerbahçe (1), women (1), Tuğba teacher (1), mind (1)	89	31

As can be seen in Table 4, 69 different metaphors were produced for the conceptual category of "Positive or negative emotions". These metaphors were preferred by 31% (f=89) of the participants. In other words, 31% of the participants preferred metaphors that fell into this category. The metaphor of "live" was used the most (f=10) in this category. The statements of the selected teacher candidates for this category are as follows:

> *Mathematics is like "**life**". Because it is difficult, it always teaches us lessons. It comes across us in every field, there are many subjects it is connected to (ESEF2); Mathematics is like "**a punishment**" given to us. Because I can't handle every problem I encounter (PTF5); Mathematics is like "**a maze**". Because, a result is reached by going through winding paths. We are happy when we reach the result. Its existence is necessary for us. It contributes a lot to our lives (PTF8); Mathematics is like "**nothingness**". Because it has no meaning or contribution to my life (PTF14); Mathematics is like "**life**". Because life is beautiful for those who can do and live. It is like hell for those who cannot. It becomes unlivable and unbearable (SEF1); Mathematics is like "**disappointment**". Because no matter how well you try to do it, it ends badly. It is the key that takes you to the goal you want, but it leaves you halfway. It steals your dreams (SEF2); Mathematics is like "**a door handle**". Because it opens every door. Every door that opens takes you to a new world and offers beauty. It makes many things easier in life (SEF5); Mathematics is like "**a child**". Because it can ask different, unexpected questions. It can leave you alone with different problems (EMEF7); Mathematics is like "**a game**". Because it is like solving puzzles. It is fun (EMEF10); Mathematics is like "**the sea**". Because if you know how to swim you can handle it but if you don't you will get lost in it (ETF4); Mathematics is like "**your lover**". Because when you understand it and can solve it, you can be happy. When you can't understand it and can't solve it, you get angry. But you can't get away from both (ETM3); Mathematics is like "**reading a book**". Because if you love it, you will enjoy spending your time on it. If you don't love it, you won't be able to read even 3 pages (BEM2); Mathematics is like "**a rose**". Because it has both thorns and beauty (BEM3); Mathematics is like "**water**". Because the more you drink, the more you want to drink. That's why people get their water from*

*mathematics. It brings life energy to people. This energy increases the quality of their life (BEM8); Mathematics is like "**Fenerbahçe**". Because it is always a source of passion for those who love it. It aims to leave a mark in many areas by bringing those who love it together and has a dynamism that constantly develops and renews itself (MEF10); Mathematics is like "**mind**". Because mathematics is also making sense of real life. As we do in mind, thought and proof, acceptance are required. Like mind, it is complicated and difficult to understand (MEM6).*

The metaphors evaluated in the category of "a needed area in daily life" are given in Table 5. The metaphors of the prospective teachers who evaluated mathematics as needed or mandatory in daily life were included in this category.

Table 5. A needed area in daily life

Metaphors (f=24)	f	%
Life (11), water (9), food (2), language (2), living (2), shadow (2), gear wheel (1), oxygen (1), fruits at the grocery store (1), heart (1), part of life (2), swim (1), an indispensable item (1), baby's first steps (1), the handle of the axe (1), cosmetics (1), cell phone (1), brain (1), machine (1), universe (1), everything (1), breath (1) little piece of life (1), algorithm (1)	47	16,4

As seen in Table 5, there are 24 different metaphors in the "a needed area in daily life" category. These metaphors were preferred by 16,4% (f=47) of the participants. The metaphor "life" was the most (f=11) preferred in this category. The statements of the selected teacher candidates for this category are as follows:

*Mathematics is like "**life**". Because it can be an example for many events in our lives. Since mathematics has abstract and concrete aspects, I think it can be associated with life (EMEF11); Mathematics is like the "**gear wheel**". Because without it, nothing works properly or goes well (ESEF18); Mathematics is like "**fruits at the grocery store**". Because we always find it useful, we peel it and use it. It is always useful to us and we need it at every moment of our lives (ESEM2); Mathematics is like "**food**". Because just as we cannot live without food, we cannot live without mathematics (ESEM1); Mathematics is like the **foundation of life**. Because every tool used today has a relationship with mathematics. There is a mathematical calculation in almost everything, from the clothes we wear to the cars we drive (ESEM5); Mathematics is like "**water**". Because it is necessary in every area of life. Its presence provides convenience in life, its absence causes confusion and difficulties (PTF4); Mathematics is like "**an indispensable item**" for people. Because it is impossible to continue life without mathematics (PTF3). Mathematics is like "**language**". Because it allows us to express many things (SSEF1). Mathematics is like "**the universe**". Because we know that it exists in every aspect of our lives (SSEM7); Mathematics is like breathing. Because it is "**a part of life**", a knowledge that we will refer to at every moment of life (SEF14); Mathematics is like "**swim**". Because you learn by practicing and you never know when you will come across a situation where you need to use it (ETF13); Mathematics is like "**a shadow**". Because it doesn't leave you alone. It appears everywhere and in every field. You have to know how to use it (BEF5).*

Metaphors evaluated in the conceptual category of cumulative, evolving and changing are given in Table 6. Metaphors of prospective teachers who evaluated mathematics as producing cumulative information over time, constantly developing and changing are included in this category.

Table 6. Cumulative, evolving and changing

Metaphors (f=32)	f	%
Garden (1), all-encompassing circle (1), bee (1), game (1), tree (1), computer (1), language (1), spiral (1), chain (2), play dough (1), end of episode monster (1), wallet (1), jigsaw (1), river (1), puzzle (2), fruit (1), wheel (1), algorithm (1), old embroidered chest (1), family tree (1), love (1), endless loop (1), flower petals (1), factory (1), train tracks (1), chain ring (1), skyscraper (1), multi-storey building (1), magnificent and detailed structure (1), stars (1), life (2), never ending road (1)	35	12,2

As seen in Table 6, 32 different metaphors were produced for the conceptual category of "Cumulative, evolving and changing". These metaphors were preferred by 12,2% (f=35) of the participants. In this category, the metaphors of "chain", "puzzle" and "life" were used twice, while the others were used once. The statements of the selected teacher candidates for this category are as follows:

*Mathematics is like "**a garden**". Because everything you learn contributes to the future and everything you learn becomes a source for other learning (ESEF7); Mathematics is like "**a bee**". Because it constantly tries to develop and work (ESEF15); Mathematics is like "**a tree**". Because it branches out from basic operations to other operations (ESEM7); Mathematics is like "**a language**". Because it is alive by constantly changing new things added to the symbols to give it meaning according to itself. It is necessary to make an effort to understand (ESEM8); Mathematics is like "**a chain** connected to each other". Because if we cannot learn the first subject, we cannot understand any mathematical subject when we move on to other subjects. All subjects are interconnected (PTF23). Mathematics is like "**train tracks**". Because it progresses with accumulation and we cannot complete the road if one track is missing (SEM7); Mathematics is like a "**skyscraper**". Because every piece of information learned forms the basis for the next*

*piece of information. Thus, it is built and becomes a skyscraper. With the information in mathematics (axioms), new information is supported and mathematics is learned (EMEF23); Mathematics is like "**an endless loop**". Because the pool it is related to is very large and it continues by constantly adding new information to it (MEF21); Mathematics is like "**a factory**". Because just as everything in a factory has a purpose, mathematics also completes itself and forms a whole (MEM1).*

The metaphors evaluated in the versatile field category are given in Table 7. Metaphors of prospective teachers who were evaluated as associating mathematics with different disciplines and forming the basis for other sciences were included in this category.

Table 7. A versatile field

Metaphors (f=27)	f	%
Jigsaw (2), life (1), science center (1), heart (1), train (1), grains of sand in the sea (1), soup (1), knot thread (1), atom (1), roof (1), octopus (1), bag (1), bee (1), world (1), sun (1), everything (1), home (1), puzzle (1), sky (1), water (1), nature (1), rainbow (1), foundation of building (1), flowing river (1), ocean (2), desert (1), soccer team (1)	29	10

As seen in Table 7, 27 different metaphors were produced for the conceptual category of "A versatile field". These metaphors were preferred by 10% (f=29) of the participants. In this category, the metaphors "jigsaw" and "ocean" were used twice, while the others were used once. The statements of the selected teacher candidates for this category are as follows:

*Mathematics is like "**a jigsaw**". Because it is intertwined with all other disciplines and complements each other (ESEF3); Mathematics is like "**a jigsaw**". Because each piece is fed by different disciplines. When the puzzle is finished, the picture that forms explains that mathematics is the main picture that helps other disciplines (BEM9); Mathematics is like "**a science center**". Because it is related to many fields. Knowing mathematics is the most important point of establishing relationships with other fields. It has many benefits in every field in our daily lives (ESEF1); Mathematics is like "**a train**". Because a train consists of many locomotives. If we liken each locomotive to a field of mathematics, we can liken the train as a whole to mathematics itself (ESEF9); Mathematics is like "**soup**". Because it includes many disciplines. All of them create a common taste in harmony with each other (ESEF12); Mathematics is like "**an atom**". Because it is the building block of everything and every science (ESEM9); Mathematics is like "**an octopus**". Because it has a very wide field of research. It can reach many areas like the arms of an octopus. It is like what an intelligent animal like an octopus does (SSEF5); Mathematics is like "**an ocean**". Because just as it surrounds all land masses, mathematics also surrounds all branches of science (EMEF25); Mathematics is like "**an ocean**". Because it has various fields and different subjects. It is an area open to new discoveries. It has unknowns (MEF2); Mathematics is like "**a soccer team**". Because if we think of each position as a subject, we can liken each related position to related subjects. If we establish the right connections, we score a goal, in other words, we reach a result (EMEM6); Mathematics is like "**life**". Because, like life, it is a multifaceted, interconnected process consisting of different disciplines (EMEM9).*

The metaphors evaluated in the conceptual category of "*a demanding field*" are given in Table 8. The metaphors of the prospective teachers who evaluated mathematics as requiring effort, exertion and endeavor were included in this category.

Table 8. A demanding field

Metaphors (f=26)	f	%
Aquarium (1), flower (1), riddle (1), puzzle (1), passion (1), sea (1), a multiple cube (1), mountain (1), labyrinth (1), living (1), wall (1), war (1), our girlfriend (2), wheels of life (1), washing dishes (1), big and scary mountain (1), human (1), ıntelligence cube (1), philosophy (1), love (1), step (1), stairs (1), to succeed (1), soil (1), plane (1), a sour gum (1)	27	9,4

As seen in Table 8, 26 different metaphors were produced for the conceptual category of "*a demanding field*". In this category, the metaphor "our girlfriend" was used the most and the other metaphors were used once each. The statements of the selected teacher candidates for this category are as follows:

*Mathematics is like "**an aquarium**". Because, when you look from the outside, it looks very orderly. When you get into it, you make an effort to stay above water (ESEF10); Mathematics is like "**a riddle**". Because, we try to find the answer (ESEF13); Mathematics is like "**passion**". Because, the more passion you show, the more you get in return. Mathematics is a subject and a science that requires effort and turns into a passion after a while when you get the reward (ESEM10); Mathematics is like "**a multiple cube**". Because, it takes a lot of effort to solve it. A cube also takes a lot of time and effort, but once you learn it, it flows like water (PTF9); Mathematics is like "**love**". Because math and love both require effort to understand. However, both provide great satisfaction when solved (BEF14); Mathematics is like "**stairs**". Because it teaches step by step and takes you to the top. But even if there are a few missing steps in between, it becomes difficult and progress becomes impossible (MEF4); Mathematics is like "**soil**". Because the more we work on it, the more it gives us. The more we work on it, the more it gives us products. These products are different from each other and of different natures. The more we work on it, the more different products it gives. The more the cultivated soil is cultivated, the more it gives more, it gives higher quality products, and it shines even more. Just like in mathematics (MEM7). Mathematics is like "**philosophy**". Because, every step should be considered, commented on and steps should be taken accordingly (SEF17); Mathematics is like "**a***

***step"**. Because, we climb the steps slowly and patiently and those who do not give up reach their goal, that is, the result (SEF11).*

Metaphors evaluated in the "infinite" conceptual category are given in Table 9. Metaphors of prospective teachers who evaluated mathematics as an infinite field and containing multiple unknown situations were included in this category.

Table 9. Infinite

Metaphors (f=15)	**f**	**%**
Sea (1), Sky (1), Life (1), Space (3), Black hole (1), Philosophy (1), Ocean (4), Oxygen (1), x (1), Dancing with numbers (1), Pomegranate (1), Ant house (1), Outer space (1), A universe full of secrets and mysteries (1), Universe (2)	21	7,3

As seen in Table 9, 15 different metaphors were produced for the conceptual category of "infinite". These metaphors were preferred by 7,3% (f=21) of the participants. In this category, the most preferred metaphors were "ocean", "space" and "universe", while the others were used once each. The statements of the selected teacher candidates for this category are as follows:

*Mathematics is like "**the sea**". Because, there is much more information hidden in its depths, waiting to be discovered (ESEF17); Mathematics is like "**life**". Because, it contains many problems. You solve problems in order to progress. As you solve them, you understand that you are getting deepe (ESEM11); Mathematics is like "**a black hole**". Because, unless you go inside, you cannot solve its mystery. If you go inside, you will be trapped in an infinity that will never end. As you draw knowledge into this infinity, you grow (PTF1); Mathematics is like "**the ocean**". Because, it is endless. At first, when you are walking on the shores, it seems conquerable, but as you open up, you understand how impossible it is. It pulls you deep, pushes you with its storms, and if you are lucky, you come to a shore (SSEM2); Mathematics is like "**space**". Because there is always a new discovery to be made, it is constantly expanding, it is infinite. There are some entities that we are not aware of, such as objects that have only been proven to exist as equations (EMEM13); Mathematics is like "**an anthouse**". Because from the outside it looks like there are only operations, but inside it is completely different. There are infinite operations that are connected to each other underneath the operations. Just like anthills are connected to each other and go on for infinite lengths (MEF14); Mathematics is like "**a universe full of secrets and mysteries**". Because it is infinite, discoverable and endless to discover, and a universe that is enjoyable and does not tire as it is discovered (MEM17).*

The metaphors evaluated in the conceptual category of "an orderly and systematic structure" are given in Table 10. The metaphors of the prospective teachers who evaluated mathematics as having a certain systematicity, order and hierarchy were included in this category.

Table 10. An orderly and systematic structure

Metaphors (f=14)	**f**	**%**
Recipe book (1), family (1), housewife (1), ıntelligence cube (1), solar powered lamp (1), common language (1), language (1), jigsaw (1), life (2), english (1), logical system (1), learn languages (1), game (2), building building (1),	16	5,6

As seen in Table 10, 14 different metaphors belonging to the conceptual category of "an orderly and systematic structure" were produced. These metaphors were preferred by 5,6% (f=16) of the participants. In this category, the metaphors "life" and "game" was used twice, while the others were used once. The statements of the selected teacher candidates in this category are as follows:

*Mathematics is like "**a recipe book**". Because it helps us reach the desired result by bringing together the right data and steps (ESEF8); Mathematics is like "**a housewife**". Because, just as housewives keep the house orderly and tidy, mathematics makes the expressions orderly and tidy by simplifying them (ESEM4); Mathematics is similar to language because it explains facts and objects in its own style and methods (SSEM8); Mathematics is like "**family**". Because it has clear rules like a father. It is definite and unchanging. Like a mother, it can show different results in different situations. It creates a bond with different disciplines like siblings (EMEF26); Mathematics is like "**life**". Because living life as it deserves is doing the right things in the right place. Mathematics also always requires doing the right thing. It has a certain discipline in the cause-effect relationship (SEF9); Mathematics is like "**an intelligence cube**". Because all its steps complement each other. If even one step is wrong, the result will be wrong (EMEF3); Mathematics is like "**a game**". Because it is passing (proving) sections (theorems) in accordance with certain rules (definitions) (SEM4).*

The metaphors evaluated in the problem solver conceptual category are given in Table 11. The metaphors of the prospective teachers who were evaluated as producing alternative solutions to complex situations in mathematics were included in this category.

Table 11. Problem solver

Metaphors (f=13)	f	%
Teacher (1), puzzle (1), key (2), kidney (1), user manual (1), road map (1), light (1), swiss army knife (1), recipe book (1), algorithm (1), map (1), ısland map (1), life (2)	15	5,2

As seen in Table 11, 13 different metaphors belonging to the conceptual category of "problem solver" were produced. These metaphors were preferred by 5,2% (f=15) of the participants. The metaphors "key" and "life" in this category were used twice, while the others were used once. The statements of the selected teacher candidates in this category are as follows:

*Mathematics is like "**a teacher**". Because it helps us solve all problems (ESEF4); Mathematics is like "**a key**". Because it acts as a tool to solve many problems and open locks (ESEF6); Mathematics is like "**a user manual**". Because it translates abstract situations that we cannot understand into concrete ones with easily understandable symbols and helps us solve problems that we are uncomfortable with, such as we do not have a house, we will build operations, dimensions are necessary (ESEM3); Mathematics is like "**light**". Because it is a light on the students' path and helps them think and find the result of operations. It provides this to the student in excess with its certain materials (SSEF2); Mathematics is like "**a recipe book**". Because it explains how to do many things. It teaches us what we do not know. It helps us understand and think (SSEM4); Mathematics is like "**a key**". Because it is the key to solving the problems we encounter with the effect of increasing technology (MEF8); Mathematics is like "**a road map**". Because it shows you a direction where you can solve any problem with the right steps. Each step is based on the result of the previous one and takes you to the right path (ETF7).*

Metaphors evaluated in the conceptual category of "mathematics as the basis of the universe" are given in Table 12. Metaphors of prospective teachers who see mathematics as the basic source of the formation of the universe are included in this category.

Table 12. Mathematics as the basis of the universe

Metaphors (f=4)	f	%
Language (2), constantly flowing water (1), universe (1), atom (1)	5	1,75

As seen in Table 12, 4 different metaphors belonging to the conceptual category "Mathematics as the basis of the universe" were produced. These metaphors were preferred by 1,75% (f=5) of the participants. In this category, the metaphor "language" was used twice, while the others were used once. The statements of the selected teacher candidates in this category are as follows:

*Mathematics is like "**a language**". Because it contains many problems. You solve problems to progress. You understand that you are getting deeper as you solve them (ESEM6); Mathematics is like "**the universe**". Because the universe has a system within itself. It is built on a scientific or divine system and scientific discoveries up until now have been concretized with mathematics by observing the universe. The universe is founded on mathematics with scientific discoveries (SSEF14); Mathematics is like "**constantly flowing water**". Because it does not stand still. It contains a lot of beauty. It is the source of most things in the universe (EMEF15); Mathematics is like "**an atom**". Because we encounter it everywhere in the universe. Mathematics forms the basis of everything in the universe. Understanding mathematics is deciphering the code of the universe. Mathematics is everything (EMEM18).*

Metaphors evaluated in the "Other" conceptual category are given in Table 13. Metaphors that do not fall into any category are presented in this category.

Table 13. Other

Metaphors (f=2)	f	%
Cloud (1), bee (1)	2	0,7

According to Table 13, 2 different metaphors were produced for the conceptual category of "Other". These metaphors were preferred by 0,7% (f=2) of the participants. In this category, the metaphors of "cloud" and "bee" were used once each. The statements of the prospective teachers are as follows:

*Mathematics is like "**a cloud**". Because it distributes information equally to all students. It does not discriminate (ESEF11); Mathematics is like "**a bee**". Because the basis of mathematics is ratio and proportion. Ratio and proportion are like worker bees and queen bees (ESEF14).*

Discussion

When we look at the findings, it is seen that 286 teacher candidates produced 185 different metaphors. Looking at this finding, it is seen that teacher candidates produced different metaphors at a rate of approximately 65%. It can be said that this high rate is due to the fact that the participants were teacher candidates selected from different programs.

When the metaphors produced by the prospective teachers regarding mathematics are examined, it is

seen that the most produced metaphor is the metaphor of "life" (f=30, 10.49%). The metaphor of "life" was found to be f=18 (12.68%) in a study conducted by Demirkol and Ergin (2017), f=28 (21.7%) in a study conducted by Güler et al. (2012), f=34 (18.68%) in a study conducted by Güner (2013), and f=33 (10.4%) in a study conducted by Çalışıcı and Sümen (2019). Based on the results of the studies in the literature, it is possible to say that the "life" metaphor is one of the most produced metaphors in similar studies in the literature (Çalışıcı and Sümen, 2019; Demirkol and Ergin, 2017; Güler et al., 2012; Güner, 2013). In the present study, it is seen that the category with the most "life" metaphors (f=11) is "a needed area in daily life". The reason for the excessive use of the "life" metaphor is understood from the explanations of the metaphor. The participants stated that they use mathematics in daily life and that it is everywhere in life.

In the category of "a needed area in daily life", the teacher candidates who use the "life" metaphor the most are the teacher candidates in the Primary School Mathematics Teaching program. The reason why primary school mathematics teacher candidates think this way is thought to be that they have taken too many teaching courses on how to teach mathematics during their university education and have received practice-oriented training (Çalışıcı and Sümen, 2019).

The second most preferred metaphor in this study is "water" (f=11, 3.85%). However, when we look at some of the similar studies in the literature, it is seen that the most produced metaphor after the metaphor of "life" is the "puzzle". The "puzzle" metaphor was seen as f=22 (6.9%) in a study by Çalışıcı and Sümen (2019) and f=8 (5.63%) in a study by Demirkol and Ergin (2017). In this study, the "puzzle" metaphor is seen as f=7(2.44%). 9 of the teacher candidates who produced the "water" metaphor explained this metaphor in a way that it could be included in the "a needed area in daily life" category. The reason for this finding may be that prospective teachers think that water is an important element for us to continue our lives and that we need mathematics in our daily lives just as we need water. The fact that the most produced metaphors in the category of "a needed area in daily life" were "life" and "water" is consistent with the study of Çalışıcı and Sümen (2019). However, Çalışıcı and Sümen (2019) only worked with prospective Mathematics Teachers and Primary School Mathematics Teachers. In this study, prospective teachers studying in 8 different programs were included. In both studies, the fact that prospective teachers preferred the metaphors of "life" and "water" in explaining the concept of mathematics as a "needed field" can be associated with their view of mathematics as a general need for people.

When the categories are examined, it is seen that the category that stands out is the "positive or negative emotions" category. The effect of the teacher candidates in the English Language Teaching (48%), Special Education Teaching (45%) and Preschool Teaching (45%) programs is great in the prominence of this category. The reason why the teacher candidates in the English Language Teaching program have an emotionally based opinion towards mathematics may be that they did not take a mathematics course during their university education. Not taking a mathematics course may have limited their views on mathematics and their emotional feelings towards the concept of mathematics may have come to the fore. Although the Special Education teacher candidates took the Mathematics Teaching in Special Education course in the fall semester of the 3rd grade and the Preschool teacher candidates took the Mathematics Education in Early Childhood course in the fall semester of the 2nd grade, they made emotionally-oriented explanations for the metaphors they produced regarding the concept of mathematics. The reason for this may be that the content of the courses they took at university included basic information rather than the details of mathematics. The category that stood out for classroom teacher candidates was the "positive or negative emotions" (36%) category. In a study conducted by Güveli et al. (2011) on prospective classroom teachers, the most preferred categories were "an exciting lesson" (f=181) and "a difficult and boring lesson" (f=160). In the present study, prospective classroom teachers' use of metaphorical explanations containing emotions is similar to the results of Güveli et al. (2011). Except for Mathematics and Science teacher candidates, other teacher candidates preferred the "positive or negative emotions" category more.

It is seen that the prominent category for prospective mathematics teachers is "cumulative, evolving and changing" (23,8%). This finding is similar to the "content/structure" category, which is the prominent category in the study of Kantarcı and Kıral (2021). The category of "a demanding field" highlighted in the study of Çalışıcı and Sümen (2019) and the category of "need" highlighted in the study of Güler et al. (2012) differ from the category of "accumulative, developing and changing" in this study. These differences emerged with two different interpretations, namely, whether the prospective mathematics teachers viewed the concept of mathematics as a structure, even as a whole, or as an area that required effort and needed to be worked on. These interpretations may have differed due to the differentiation of the prospective teachers' class levels (since the teaching course and theoretical courses

differ according to class levels) and their experiences with the concept of mathematics.

The prominent category for science teacher candidates is "a versatile field" (16,7%). In this category, metaphors that are mostly related to science such as science center and atom and can be addressed in different dimensions were used. In this case, it can be said that the science content courses that science teacher candidates take at university also shape their thoughts on the concept of mathematics.

This study was conducted with prospective teachers studying in 8 different programs. For this reason, the study offers a more comprehensive perspective in determining the perceptions of prospective teachers towards mathematics compared to similar studies in the literature.

Conclusions

The conclusions drawn from the findings obtained from the study are given below.

The fact that the teacher candidates participating in the study were studying in different programs caused them to have different learning experiences, which led to the formation of a variety of metaphors.

The most important and clear conclusion reached in the study is that the "Life" metaphor is a metaphor preferred by a significant portion of the participants to explain the concept of mathematics.

Teacher candidates who have not taken any courses related to mathematics or who have taken limited non-theoretical teaching courses during their university education have an emotional perception towards mathematics. This emotional perception is shaped according to their past experiences with mathematics in school life. A large part of emotional perceptions consists of negative feelings. From this, it was concluded that teacher candidates who have taken a limited number of courses related to mathematics have developed negative feelings towards mathematics.

The courses that prospective mathematics teachers and primary school mathematics teachers take throughout the university differ in terms of theory and practice. The reason why prospective mathematics teachers and primary school mathematics teachers have different perceptions of mathematics depends on the courses they take.

Science content requires a certain level of mathematical knowledge, and even advanced mathematical knowledge in some science subjects. Therefore, science teacher candidates' science knowledge has an impact on their perception of mathematics. In other words, they can reconcile science and mathematics. From this, it was concluded that the field courses of science teacher candidates positively affected their perceptions of mathematics.

Looking at the findings in this study, it was seen that the experiences of the prospective teachers regarding mathematics affected how they perceived mathematics. Since there is vocational training in the university, prospective teachers who study in programs where there is no intensive or no mathematics content course continue to perceive mathematics according to their past experiences.

The general conclusion to be drawn is that the different experiences of prospective teachers regarding mathematics create differences in their perception of mathematics. The duration of participants' encounter with mathematics throughout their education and the types of their experiences significantly shape their thoughts.

Recommendations

Recommendations were made based on the results ontained from the present study. When the metaphors assigned to the positive and negative emotion categories in the study were examined, it was determined that a large part of the participants' perceptions of mathematics contained negative emotions. The expression of past experiences with negative emotions may be related to the experiences gained throughout school life. For this reason, activities can be planned in schools to make students realize that mathematics is a field needed and frequently used in daily life, and that there is mathematics behind even a simple thought. At the same time, activities that will develop the mathematical thinking skills of students with negative perceptions of mathematics should be included in the curriculum. In this direction, teaching can be done with a more comprehensive perspective by taking into account the four basic objectives of mathematics education (valuing mathematics, gaining mathematical thinking skills, using mathematics as a means of communication, and gaining problem-solving skills) (Baki, 2020).

Considering that teachers are effective in shaping students' thoughts about mathematics (Şahin, 2013), fun and daily life-oriented mathematics activities, projects and seminars can be organized for teacher candidates with negative perceptions of mathematics in order to change their perceptions about mathematics.

Similar studies can be conducted with teacher candidates studying at different universities to compare perceptions of mathematics across universities. In this way, it can be determined how the perceptions of mathematics of people studying and living in different regions are affected by the region they live in.

Bibliography

Aydın, E., & Sulak, S. E. (2015). Sınıf öğretmeni adaylarının "değer" kavramına yönelik metafor algıları. Bartın University Journal of Faculty of Education, 4(2), 482-500.

Ayyıldız, T. (2016). Üniversite öğrencilerinin dans kavramına yönelik metaforik algılarının analizi. Gaziantep Üniversitesi Spor Bilimleri Dergisi, 1(2), 13-26.

Baki, A. (2020). Matematiği Öğretme Bilgisi (3. baskı). Ankara: Pegem Akademi.

Bıyıklı, C., Başbay, M., & Başbay, A. (2014). Ortaokul ve lise öğrencilerinin bilim kavramına ilişkin metaforları. Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi, 17(1), 414-437.

Can, A. A. (2021). İlkokul dördüncü sınıf öğrencilerinin matematik problemi çözmeye ilişkin algılarının metaforlar yoluyla analizi. Uşak Üniversitesi Eğitim Araştırmaları Dergisi, 7(1), 103-118.

Çalışıcı, H., & Sümen, Ö. Ö. (2019). Matematik öğretmen adaylarının matematiğe yönelik algıları: bir metafor çalışması. International Journal of Educational Studies in Mathematics, 6(3), 108-123.

Çapar, M. C., & Ceylan, M. (2022). Durum çalışması ve olgubilim desenlerinin karşılaştırılması. Anadolu Üniversitesi Sosyal Bilimler Dergisi, 22(2), 295-312.

Demir, C., & Yıldırım, Ö. K. (2019). Türkçede metaforlar ve metaforik anlatımlar. Afyon Kocatepe Üniversitesi Sosyal Bilimler Dergisi, 21(4), 1085-1096.

Demircioğlu, G. (2023). Öğretmen adaylarının iletişim kavramına yönelik algıları: Bir metafor analizi. Karadeniz Teknik Üniversitesi İletişim Araştırmaları Dergisi, 13(1), 64-96.

Demirkol, N., & Ergin, D. Y. (2017). Matematik öğretmen adaylarının matematik ve matematik öğretmenliği metaforik algılar. Dimitrov, Nikoloski and Yılmaz (Eds.) IV. International Balkan and Near Eastern Social Science Congres Series – Russe / Bulgaristan bildiriler kitabı içinde (s.713-751).

Doğan, Y. (2017). Ortaokul öğrencilerinin çevre kavramına ilişkin sezgisel algıları: bir metafor analizi. Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi, 18(1), 721-740.

Elalmış, S., Demirkıran, F., & Doğan, E. E. (2023). Matematik dersine yönelik tutum ile başarı arasındaki ilişki: Bir TİMSS çalışması. Edebiyat Dilbilim Eğitim ve Bilimsel Araştırmalar Dergisi, 2(1), 147-157.

Ersan, O., & Aktan, D. Ç. (2024). Öğrencilerin sosyoekonomik durumu, içsel motivasyonu ve okulun başarıya verdiği önemin öğrencilerin matematik başarılarına etkisi. Yaşadıkça Eğitim, 38(1), 152-170.

Ertürk, R. (2017). İlkokul öğrencilerinin "öğretmen" kavramına ilişkin metaforik algıları. E-Uluslararası Eğitim Araştırmaları Dergisi, 8(3), 1-15.

Filiz, S. B. (2018). Pedagojik formasyon öğrencilerinin matematik kavramına ilişkin metaforik algıları. Uluslararası Eğitim Bilimleri Dergisi, 5(15), 251-269.

Güler, G., Akgün, L., Öçal, M. F., & Doruk, M. (2012). Matematik öğretmen adaylarının matematik kavramına ilişkin sahip oldukları metaforlar. Eğitim ve Öğretim Araştırmaları Dergisi, 1(2), 25-29.

Güner, N. (2013). Öğretmen adaylarının matematik hakkında oluşturdukları metaforlar. Education Sciences, 8(4), 428-440.

Güneş, A., & Fırat, M. (2016). Açık ve uzaktan öğrenmede metafor analizi araştırmaları. Açıköğretim Uygulamaları ve Araştırmaları Dergisi, 2(3), 115-129.

Güveli, E., İpek, A. S., Atasoy, E., & Güveli, H. (2011). Sınıf öğretmeni adaylarının matematik kavramına yönelik metafor algıları. Turkish Journal of Computer and Mathematics Education, 2(2), 140-159.

Habacı, Ş. D., & Çetin, İ. (2023). Lise öğrencilerinin sonsuzluk kavramına ilişkin metaforları. Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi, 24(2), 1108-1161.

Hacıfazlıoğlu, Ö., Karadeniz, Ş., & Dalgıç, G. (2011). Okul yöneticilerinin teknoloji liderliğine ilişkin algıları: Metafor Analizi örneği. Eğitim Bilimleri Araştırma Dergisi, 1(1), 97-121.

Karakuş, N., & Karacaoğlu, M. Ö. (2021). Uzaktan eğitime yakından bakış: bir metafor çalışması. Rumelide Dil ve Edebiyat Araştırmaları Dergisi, (Ö10), 44-62.

Polat, M., Polat, H., Saldüz, İ., Polat, İ., Polat, M., Öter, D. K., & Kılıç, B. (2022). Lisansüstü öğrencilerin lisansüstü eğitime ilişkin görüşleri. The Journal of International Lingual Social and Educational Sciences, 8(1), 42-57.

Saatçioğlu, F. M. (2023). Örtük profil analizi ile öğrencilerin matematik tutum profillerinin belirlenmesi üzerine bir araştırma. Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi, 43(3), 1623-1643.

Saban, A., Kocbeker, B., N., & Saban, A. (2007). Prospective teachers' conceptions of teaching and learning revealed through metaphor analysis. Learning and Instruction, 17(2), 123-139 https://doi.org/10.1016/j.learninstruc.2007.01.003

Sarı, C., Kılıç, A. F., Güven, S., & Yaşar, H. B. (2020). Üniversite öğrencilerinin kültürel miras kavramına ilişkin algılarının metafor analizi yoluyla incilenmesi. International Journal of Current Approaches in Language, Education and Social Sciences, 2(1), 334-353.

Saylık, A., Saylık, N., & Sağlam, A. (2021). Eğitimcilerin gözünden Türk eğitim sistemi: Bir Metafor Çalışması. Van Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi, 18(1), 522-546.

Şad, S. N. (2023). Ortaokul 8. sınıf öğrencilerinin "yeni nesil soru" kavramına ilişkin algılarının metafor yoluyla incelenmesi. İnönü Üniversitesi Eğitim Fakültesi Dergisi, 24(1), 378-399.

Şahan, K. (2017). Metafor ne değildir? Kesit Akademi Dergisi, 8, 166-176.

Şahin, S. M., & Baki, A. (2013). Matematik gücünün değerlendirilmesi. Bayburt Eğitim Fakültesi Dergisi, 8(1), 195-215.

Taşkın, N., Dağaynası, S., & Ayaz, M. (2024). Erken matematik inanç ve güven ölçeğinin Türkçe'ye uyarlanma çalışması. Erzincan Üniversitesi Eğitim Fakültesi Dergisi, 26(3), 446-459.

Uçar, Z. T., Pişkin, M., Akkaş, E. N., & Taşçı, D. (2010). İlköğretim öğrencilerinin matematik, matematik öğretmenleri ve matematikçiler hakkındaki inançları. Eğitim ve Bilim, 35(155), 132-144.

Ünsal, S., Korkmaz, F., & Çetin, A. (2016). Lise öğrencilerinin "felsefe" kavramına yönelik metafor algılarının incelenmesi. Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi, 16(3), 1047-1064.

Yapıcıoğlu, A. E., & Korkmaz, N. (2019). Öğretmen adaylarının fen ve matematiğe yönelik algılarının belirlenmesi: metafor çalışması. Akdeniz Eğitim Araştırmaları Dergisi, 13(29), 400-420.

This article has been scanned by plagiarism detection softwares. No plagiarism detected.

Ethical approval for this study was obtained from the Scientific Research and Publication Ethics Committee for Social and Human Sciences of Trabzon University in 2025.