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Determining the Perceptions of Teacher Candidates on the Concepts of Science Course, Science Laboratory, Science Teacher and Science Student via Metaphors

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Abstract

The purpose of this study is to determine the perceptions of teacher candidates on the concepts of science course, science laboratory, science teacher and science student using metaphors. In this study, the phenomenological research method was used. The participants consisted of a total of 58 first year students who are studying at the department of Science Education at a state university located in the Eastern Black Sea Region in Turkey. The data of the study was obtained by asking the students to complete the sentences "a science course is like …, because …", "a science laboratory is like …, because …", "a science teacher is like …, because …" and "a science student is like …, because…". In this study which used the research design of phenomenology in the scope of a qualitative research approach, the obtained data was analyzed using the method of content analysis. The most frequently mentioned metaphors in the study by the teacher candidates were "life" for the concept of science course, "fun" for the concept of science laboratory, "mother" for the concept of science teacher and "dough" for the concept of science student. According to the results of the study, it was observed that most teacher candidates perceived the concept of science course as "understanding/discovering life (26.3%) and infinite (21%)", the concept of science laboratory as "a place that provides experience (22.7%) and entertainment (22.6%)", the concept of science teacher as "mentor (25%)" and the concept of science student as "a valuable being (20%)". It was also observed that the perceptions of the teacher candidates on science were generally positive.

Introduction

Science is the essence of knowledge and skills that trigger people to understand and interpret the environment that they live in and their thoughts of looking for an order in this complex environment (Hançer, Şensoy and Yıldırım, 2003). The science course is an important course that prevents the student from falling behind the times not only because it provides information that we can use in all aspects of our lives through its branches of physics, chemistry and biology, but also due to the ever changing and advancing structure of technology content (Buyruk and Korkmaz, 2016). Therefore, as a part of daily life, sciences facilitate students' preparation for life by providing significant contributions to their comprehension of the nature and the relationships in the nature. Considering that almost all topics covered by sciences are related to the events and the results of these events in the immediate surroundings, namely the daily life, of the individual, the importance of the science course may be understood better (Ayas, Karamustafaoğlu, Sevim and Karamustafaoğlu, 2001). Additionally, sciences undeniably have great importance in training individuals who will keep up with the rapidly changing and advancing era of science and be able to utilize the latest technological inventions in every field (Hançer, Şensoy and Yıldırım, 2003), will inquire, question, produce solutions to problems they encounter in daily life, have high-level thinking skills and be able to produce information and use it when necessary (Kuşakçı-Ekim, 2007).

The most important advantage of science courses is that they provide students of the course with opportunities to convert theoretical knowledge into practice through laboratories (Ceyhun and Karagölge, 2001; Ültay and Ültay, 2009). Science laboratories are controllable environments whose limits are determined, where a topic or concept that is to be taught artificially provided to students by demonstration or via firsthand experience (Ceyhun and Karagölge, 2001; Güneş, Şener, Germi and Can, 2013). Experiments carried out in laboratories and the process of experimentation provide students with tangible experiences not only in terms of learning scientific concepts but also with regards to implementation of the process of reaching information (Yıldız,

Akpınar, Aydoğdu and Ergin, 2006). Moreover, laboratory environments are places where a problem is defined, hand skills and operational capabilities are improved, questions that arise out of multiple observations and abstract perceptions are made sense of through materialization, and it is understood that the information gathered has a crucial value (Güneş et al., 2013). According to Algan (1999) and Staeck (1995), rather than the behavior of memorizing information, laboratory practices will provide positive contribution to students in terms of making observations, learning about ways of using information, understanding scientific concepts, keeping these in mind, thinking critically, producing and interpreting ideas and adapting them into daily life, and improving their personal skills and talents (Kaya and Böyük, 2011). Likewise, Hofstein and Lunetta (2004) stated that laboratory applications not only help better understand the concept or topic, they also affect understanding of inquiry, critical thinking and science, and teach students ways of producing information. With the help of laboratory applications, individuals will have the chance to apply what they have learned through science education in practice and increase the permanence of learning (Güneş and Karaşah, 2016). Moreover, it was reported that laboratory practices that are carried out correctly and effectively facilitate students' development of positive attitudes towards science topics (Güneş et al., 2013). It was also reported that laboratory applications are effective in developing positive attitudes towards science education and students' success in science (Freedman, 1997; Hofstein, Navon, Kipnis and Mamlok-Naaman, 2005). Therefore, laboratory applications are an indispensable part of science education and the importance and necessity of laboratory applications are prominent for more effective and meaningful understanding of science topics.

It is known that what make science education effective are infrastructure, laboratory and similar units, a suitable educational model and teachers who are operators of such a model, and inadequacy of any of these factors affects the education system negatively (Morgil and Yılmaz, 1999). The element of teacher is in the focus of an education system among its fundamental elements (Erdemir, 2007; Çakır-İlhan, 2005; Karahan, 2008). According to Böyük, Demir and Erol (2010), the teachers, as the person who improves and direct education and facilitates continuous attention of students, are one of the most effective elements of the process of education. Similarly, according to Taşkaya (2012), they are also primarily responsible for the education of the students in the classroom as a part of their duty. Therefore, the qualities of the teacher also affect the quality of these processes. Additionally, the teacher has important duties in shaping the society and establishing the future, and this calls for inquiry into teachers' qualities. This is because only qualified teachers can provide qualified education for students who will build the future of the society, and a qualified education is directly related to the qualities a teacher has (Taşkaya, 2012). With the help of qualified teachers, it is thought that it will be possible to train individuals who inquire, question, produce solutions to problems they encounter in daily life, have high level thinking skills, are able to produce information and use it when needed, are able to keep up with the changing and advancing era of science, namely individuals who are scientifically literate, as well as carrying out effective laboratory applications, and this way, the quality of education may be increased. This is one of the fundamental objectives of science education (Saxena, 1994; cited in Aktamış and Ergin, 2006; MEB, 2013). At this point, it is important that teacher candidates, who will be the teachers of the future, have positive perceptions towards sciences, not only for science education to reach its goals, but also for qualified education and training of students who are another significant element of an education system.

The purpose of this study is to determine the perceptions of teacher candidates on the concepts of science course, science laboratory, science teacher and science student by using metaphors. The concepts of science course, science laboratory, science teacher and science student are closely interrelated concepts, and revealing how teacher candidates perceive these concepts may provide information on how they will approach and behave against these concepts not only through their undergraduate education but also in their future professional life. In other words, this study may provide general information on the attitudes and images of teacher candidates on sciences. In this context, the way teacher candidates perceive the concepts of science course, science laboratory, science teacher and science student has importance. This is because it is reported that the perceptions of an individual have an effect on their behaviors and attitudes (Schreiner, 2010). In addition to this, while attitudes towards sciences play a large role on students' decisions towards improving their knowledge related to sciences, their selection of occupations related to sciences and their usage of scientific concepts and methods productively through their life (Anıl, 2009), are also important for an effective science education. Similarly, positive attitudes of teacher candidates towards science instruction will be reflected on their students during their future professional life and this may contribute to students' presentation of positive attitudes towards sciences. This is because individuals who attend education faculties to become teachers, at the same time, bring along informal observations they have made during their university years and various personal attitudes they have developed regarding phenomena such as learning, teaching and school in connection to the experiences they have gained via their communication and interactions with their teachers who have different traits (Saban, 2004). On the other hand, a teacher candidate who has developed a negative attitude towards sciences may also lead their students they will train in their future professional life to have negative attitudes towards sciences, students may

find it difficult to understand scientific concepts and it may be expected that students will show resistance against activities that will be included (Menis, 1989; cited in Özden, Kara and Tekin, 2008). Considering these perspectives and the fact that building interest in science topics, and more effective and meaningful learning and teaching may only be achieved by teacher candidates' development of positive attitudes, it is highly important to determine the perceptions of science teacher candidates on the concepts of science course, science laboratory, science teacher and science student.

Method

In this study which aims to present the perceptions of teacher candidates on the concepts of science course, science laboratory, science teacher and science student without introducing any intervention, the phenomenological research method was used. The reason for this is that phenomenology studies are concerned with issues of how people perceive a phenomenon, how they describe it, how they remember it, how they interpret it and the nature of the language they use to transfer it to other people (Patton, 2001). A phenomenological study is the gathering of the lived experiences of a few people regarding a phenomenon or concept around a common theme (Creswell, 2013). With the help of this method, it will be possible to collect first hand, in-depth information on the issue through the current perceptions of teacher candidates on the concepts of science course, science laboratory, science teacher and science student, and their sense-making processes in relation to the reasons for this (Yıldırım and Şimşek, 2013).

Participants

The participants consisted of 58 first year students studying at the department of science education at a state university located in the Eastern Black Sea region in Turkey. Easily accessible sample which is one of the methods purposive sampling was used in the selection of the participants. Also, the participants were included in the study on a voluntary basis.

Data Collection Tool

It is seen in recent years that metaphor studies are frequently conducted for determining perceptions of participants on a topic or a subject (Akgün, 2016; Aktamış and Dönmez, 2016; Derman, 2014; Durukan, Hacıoğlu and Dönmez-Usta, 2016; Kahyaoğlu, 2015; Kaya, 2014; Paliç-Şadoğlu and Uzun, 2014; Saban, 2009; Yılmaz, Esentürk, Tekkurşun-Demir and İlhan, 2017). A metaphor may be defined as an explanation of an event, concept or phenomenon by likening it to another event, concept or phenomenon (Oxford, Tomlinson, Barcelos, Harrington, Lavine, Saleh and Longhini, 1998; Aslan, 2013; Aydın and Eser Ünaldı, 2010; Saban, 2008). Metaphors are linguistic tools discovered by humanity to understand and explain the world (Lakoff and Johnson, 2015). In addition to this, metaphors are strong mental tools that may be effective in understanding and explaining a complex and intangible phenomenon or concept by supporting it with tangible images (Yob, 2003). Through metaphors, abstract concepts that we use in our lives or those we have experiences with are restructured using more meaningful, easily understandable and tangible concepts in our lives (Lakoff and Johnson, 2015). In this sense, effectiveness of metaphors in explaining abstract phenomena, concepts or subjects makes them effective tools that may be used to determine the perceptions, attitudes and views of individuals regarding different phenomena and subjects (Buyruk and Korkmaz, 2016; Saban, 2004; Sezgin, Koşar, Koşar and Er, 2017).

Three basic elements are mentioned that are important in developing a metaphor relationship (Forceville, 2002). These elements are: (1) the subject of metaphor, (2) its source and (3) the characteristics/relationships as reasons for likening the source and the subject of the metaphor. As an example for this: In the statement "a university instructor is like Google, because they say 'did you mean?' when we ask a question" (Tortop, 2013), "the university instructor" is the subject of the metaphor, "Google" is the source of the metaphor and "saying 'did you mean?' to asked question" is the characteristic/relationship that is the reason for likening the university instructor to Google. Therefore, in any metaphor relationship, the source of the metaphor plays the role of a filter in understanding and explaining the subject of the metaphor with a different point of view (Saban, 2004).

The data of the study were collected by supplying the teacher candidates with a form that contains the metaphor templates below.

- "A science course is like …, because …",
- "A science laboratory is like …, because …",
- "A science teacher is like …, because …",
- "A science student is like …, because …".

Before collecting the data, the structure of a metaphor was explained to the teacher candidates and a few examples were provided. The participants were free to produce as many as metaphors using the metaphor templates. Additionally, the teacher candidates were given a class hour to be able to produce their metaphors comfortably.

Data Analysis

The study by Bıyıklı, Başbay and Başbay (2014) was utilized in the analysis and interpretation process of metaphors, and the steps of "denotation", "classification", "reconstruction and organization", "category development" and "achievement of validity and reliability" were followed.

Denotation Step; An alphabetically-ordered temporary list (research, computer, an unknown place, etc.) was established by defining the metaphors created by the teacher candidates for each concept. For this purpose, it was checked whether a certain metaphor was expressed clearly or not, and the data where no metaphor was defined were separated as 'no metaphor'.

Classification Step; At this stage, each metaphor was separated using the content analysis technique, and analyzed in terms of their similarities and differences to other metaphors. The main goal in content analysis is to gather similar data in the framework of certain concepts and themes, and organize and interpret them in a way that the reader would understand (Yıldırım and Şimşek, 2013). The metaphors created by the participants were reviewed and each metaphor image was analyzed in terms of 1) the subject of the metaphor, 2) the source of the metaphor, 3) the relationship between the metaphor's subject and source. The data that did not contain any metaphor images or any reason for a metaphor were eliminated.

Reconstruction and Organization Step; The concept of science course had 57 valid metaphors with 32 different source concepts, science laboratory had 53 valid metaphors with 32 different source concepts, science teacher had 56 valid metaphors with 31 different source concepts and science student had 55 valid metaphors with 36 different source concepts. The obtained metaphors were reordered alphabetically, the raw data were reevaluated, and a few examples of metaphor statements were selected to represent each metaphor. For each metaphor that was obtained regarding the concepts of science course, science laboratory, science teacher and science student, a metaphor list (e.g. "life", "experiment") was created by organizing the metaphor images of teacher candidates that were thought to represent metaphors the best. This list was used in collecting the metaphors under a certain category.

Category Development Step; Considering all the metaphors expressed by the teacher candidates regarding each of the concepts of science course, science laboratory, science teacher and science student and the reasoning given by them while explaining the metaphors, common features were determined and themes which were thought would represent these were established. The previously created metaphor list was used as a reference point in collecting the metaphors under a certain category (e.g. "understanding life", "infinite"). As determined at this stage, the concept of science course had 9, the concept of science laboratory had 12, the concept of science teacher had 10 and the concept of science student had 11 conceptual categories.

Achievement of Validity and Reliability; In order to determine whether the metaphors provided under the categories regarding each of the concepts of science course, science laboratory, science teacher and science student represented the category in question or not, the study consulted the opinion of a faculty member who taught a postgraduate qualitative data analysis course. Miles and Huberman's (1994) agreement percentage formula [agreement percentage = agreement / (agreement + disagreement)] was used to determine the consensus during data analysis, and it was found that the agreement percentage among the researchers was 87 for the concept of science course, 85 for the concept of science laboratory, 86 for the concept of science teacher and83 for the concept of science student. The data were coded in a way to prevent revelation of the identity of the participants and quotes were included. Additionally, in order to achieve validity of the results reached in the study, it was attempted to provide raw data in the findings section and to explain the data analysis process in the method section as in much detail as possible.

Results

The findings obtained by the responses of the teacher candidates to the open-ended questions that were asked to reveal their perceptions regarding the concepts of science course, science laboratory, science teacher and science student are provided in this section. The sources of the metaphors produced by the teacher candidates regarding the concept of "science course" are given in Table 1.

Table 1. Sources of metaphors produced regarding the concept of science course

Source Name	f	%	Source Name	f	%	Source Name	f	%
Life	12	21.1	Wonder	2	3.5	Precision scale	1	1.7
Experiment	4	7.1	Computer program	1	1.7	Research	1	1.7
Space	3	5.3	Fashion	1	1.7	Rose	1	1.7
Beyond class	2	3.5	Fighting difficulties	1	1.7	Seeing the truths	1	1.7
Nature	2	3.5	Foundation of the building	1	1.7	Source of curiosity	1	1.7
Book	2	3.5	Fun time	1	1.7	Sun	1	1.7
Food	2	3.5	Gravity	1	1.7	Torture	1	1.7
Light	2	3.5	Hill	1	1.7	Universe	1	1.7
Opportunity	2	3.5	Mine	1	1.7	Unknown place	1	1.7
Poet	2	3.5	NASA	1	1.7	Vines	1	1.7
Puzzle	2	3.5	Need	1	1.7			

As seen in Table 1, the teacher candidates produced 32 different metaphors. According to the table, it is seen that the metaphor "life" was the most frequently expressed. Considering the metaphor sources used by the participants regarding the concept of "science course" and the explanations/reasoning made for these metaphors, the metaphors were provided under the categories given in Table 2 based on their common features.

Table 2. Categories formed based on the metaphors created by the participants regarding the concept of science course

Categories	Metaphor Sources	f	%	Related Quotes
1.Understanding and discovering life	Experiment(4), *Life*(4), Beyond class(2), *Poet*(1) Research(1), Mine(1), Rose(1), *Puzzle*(1)	15	26.3	"A science course is like an experiment, because we always learn about a new thing about daily life at the end of an experiment." S33 "A science course is like life, because we meet examples from sciences in all stages of life." S20 "A science course is like a poet, because it tries to understand and make sense of life." S2 "A science course is like a puzzle, because it consists of a combination of several pieces." S14 "A science course is like a rose, because it consists of layers that hide hidden information. You can reach the secret inside as you unfold it." S36
2. Infinite	*Life*(5), Space (3), Nature (2), Universe (1), Vines (1)	12	21	"A science course is like life, because as you learn, the amount of things to learn increases." S1 "A science course is like space, because it is a place that reaches infinity and you meet an unknown at every point." S6 "A science course is like vines, because it forms a spiral that includes every topic." S44
3. Curiosity-Inspiring	Wonder (2), Source of curiosity (1), NASA(1), *Poet* (1), *Book* (1),Unknown place (1)	7	12.3	"A science course is like a wonder, because we are doing interesting things." S37 "A science course is like NASA, because what it aims inspires curiosity." S42
4. Changing and improving	*Life* (3), *Puzzle* (1), Fashion (1), Computer program (1)	6	10.6	"A science course is like life, because it is based on innovations and experiences." S17 "A science course is like a puzzle, because not everything is as it seems, you build it, destroy it, do something new and thus learn." S9
5. Informative / Guiding	Light (2), Seeing truths (1), Sun (1),*Book* (1), Precision scale (1)	6	10.6	"A science course is like light, because it enlightens you." S35 "A science course is like seeing the truths, because it provides us with a logical explanation of everything." S29

6. Basic need	Food (2), Need (1), Foundation of the building (1)	4	7.0	"A science course is like eating, because we need it." S10 "A science course is like a need, because we meet it at every point of our lives." S30
7. Requiring struggle	Fighting difficulties (1), Hill (1), Torture (1), Gravity (1)	4	7.0	"A science course is like a hill, because we struggle a lot to climb a hill and get tired. Just like we struggle and get tired to succeed in a science course…" S7 "A science course is like gravity, because even if we want to be free of it, we cannot. It is everywhere." S45
8.Making life easier	Opportunity (2)	2	3.5	"A science course is like an opportunity. If you utilize the opportunity well, you can easily solve a problem you encounter." S51
9. Entertaining	Fun time (1)	1	1.7	"A science course is like fun time, because we are having fun and learning by doing fun things". S8

*In Table 2, some metaphor sources are italicized because it is used in more than one category

The metaphors produced by the teacher candidates regarding the concept of science course were collected under 9 categories as understanding and discovering life, infinite, curiosity-inspiring, changing and improving, informative/guiding, basic need, requiring struggle, making life easier and entertaining. It is seen that most of the metaphors produced regarding this concept were distributed under the categories understanding and discovering life (26.3%) and infinite (21%). The sources of the metaphors produced by the teacher candidates regarding the concept of "science laboratory" are given in Table 3.

Table 3. Sources of metaphors produced regarding the concept of science laboratory

Source Name	f	%	Source Name	f	%	Source Name	f	%
Fun	7	13.0	Alchemy	1	1.9	Miniature universe	1	1.9
Life	4	7.5	Beyond settings	1	1.9	Moderation	1	1.9
Experiment	3	5.6	Computer	1	1.9	Mother	1	1.9
Kitchen	3	5.6	Crop field	1	1.9	Pot	1	1.9
Playground	3	5.6	Discomfort	1	1.9	Prison	1	1.9
Environment	2	3.8	Foundation of the building	1	1.9	Puzzle	1	1.9
Food	2	3.8	Freedom	1	1.9	Reaching truth	1	1.9
Home	2	3.8	Imagining	1	1.9	Shipyard	1	1.9
Informative party	2	3.8	Information machine	1	1.9	Surgery	1	1.9
Turning coal into gold	2	3.8	Kindergarten	1	1.9	Tool	1	1.9
World	2	3.8	Microscope	1	1.9			

As seen in Table 3, the teacher candidates produced 32 different metaphors. According to the table, it is seen that the metaphor "fun" was the most frequently expressed. It was followed by the source concepts of "life, experiment, kitchen and playground". Considering the metaphor sources used by the participants regarding the concept of "science laboratory" and the explanations/reasoning made for these metaphors, the metaphors were provided under the 12 categories given in Table 4 based on their common features.

Table 4. Categories formed based on the metaphors created by the participants regarding the concept of science laboratory

Categories	Metaphor Sources	f	%	Related Quotes
1. Place for gaining experience	Life (4), Environment (2), *Home* (1), Surgery (1), Pot (1), Kindergarten (1), *Food* (1), Beyond settings (1)	12	22.7	"A laboratory is like life, because it teaches you by living." S10 "A laboratory is like home, because there is division of labor." S24 "A laboratory is like surgery, because it leads us to understand the theoretical knowledge we have by practice." S26 "A laboratory is like a pot, we cook as long as we are in it." S29 "A laboratory is like a kindergarten, because we are learning everything by trying." S23
2. Entertaining	Fun (7), *Playground/park* (2), Informative party (2), Puzzle(1)	12	22.6	"A laboratory is like fun, because I have fun while conducting experiments." S44 "A laboratory is like a playground, because it is an entertaining setting." S15 "A laboratory is like an informative party. It teaches while having fun." S34 "A laboratory is like completing a puzzle, because it consists of several pieces and if you connect these pieces, you end up with a beautiful result." S36

3. Way to reach information	Experiment (3), Mother (1), Turning coal into gold (2), Computer (1), Microscope (1),	8	15.1	"A laboratory is like experimenting, because we reach information by doing things in the laboratory." S5 "A laboratory is like a mother, because we gain our experiences from our mother, and in a laboratory, we apply what we have learned." S3 "A laboratory is like turning coal into gold, because we sometimes try to reach a known result, but sometimes aim to get the unknown." S38
4.Creative setting	Imagining (1), Crop field (1), *Food* (1), *Kitchen* (1), Freedom (1)	5	9.4	"A laboratory is like imagining, because it shapes imagination." S45 "A laboratory is like a field, because you reap what you sow" S41 "A laboratory is like food, because different ingredients may provide different results." S35 "A laboratory is like a kitchen, because you can improve an existing thing by adding new things." S22 "A laboratory is a place of freedom, because it is a place where a person can act freely and learn about new things." S12
5.Materials depot	*Kitchen*(2), *Playground* (1)	3	5.6	"A laboratory is like a kitchen, because there are all kinds of tools in it." S28 "A laboratory is like a playground, because of the tools in it." S9
6. Infinite	World (2), Information machine (1)	3	5.6	"A laboratory is like the world, because as you do research, there is more to learn." S1 "A laboratory is like an information machine, because we are receiving new information in it." S17
7.Boring place	Prison (1), Discomfort (1)	2	3.8	"A laboratory is like a prison, because it is a closed environment." S43
8. Curiosity-inspiring place	Miniature universe (1), Alchemy (1)	2	3.8	"A laboratory is like a miniature universe, because we are creating reactions with our own hands." S18
9.Making life easier	Tool (1), Shipyard (1)	2	3.8	"A laboratory is like a shipyard, because it helps operations." S32 "A laboratory is like a tool, because it is a step for research." S14
10. Limited	Home (1), Moderation (1)	2	3.8	"A laboratory is like moderation, because excessive behavior is problematic. Everything should be precise while experimenting in a laboratory." S6 "A laboratory is like a home, because if we know about the material and combine it correctly, it becomes durable." S2
11. Basic need	Foundation of the building (1)	1	1.9	"A laboratory is like the foundation of a building, because it sets the foundation of science." S7
12. Guiding	Reaching truth (1)	1	1.9	"A laboratory is like reaching truth, because we are seeing the proof of what we have learned about in the classroom." S21

*In Table 4, some metaphor sources are italicized because it is used in more than one category.

The metaphors produced by the teacher candidates regarding the concept of science laboratory were collected under 12 categories. Accordingly, it is seen that a considerable part of the metaphors produced regarding this concept were distributed under the two categories as place for gaining experience (22.7%) and entertaining (22.6%). Additionally, there were also participants who described a laboratory as a way for reaching information (15.1%). The sources of the metaphors produced by the teacher candidates regarding the concept of "science teacher" are given in Table 5.

Table 5. Sources of metaphors produced regarding the concept of science teacher

Source Name	f	%	Source Name	f	%	Source Name	f	%
Mother	6	10.7	Book	1	1.8	Machine	1	1.8
Tree	5	8.9	Compass	1	1.8	Miner	1	1.8
Good instructor	4	7.0	Computer teacher	1	1.8	Newton who discovered gravity	1	1.8
Guide	4	7.0	Encyclopedia	1	1.8	One who balances the precision scale	1	1.8
Scientist	4	7.0	Engineer	1	1.8	Painter	1	1.8
Researcher	3	5.4	Father	1	1.8	Steep hill	1	1.8
Fun educator	2	3.6	Google	1	1.8	Sunlight	1	1.8
Genius	2	3.6	Head of the household	1	1.8	Very knowledgeable	1	1.8
Guidebook	2	3.6	Intellect	1	1.8	Water	1	1.8
Key	2	3.6	Leader	1	1.8			
Like me	2	3.6	Light	1	1.8			

As seen in Table 5, the teacher candidates produced 31 different metaphors. According to the table, it is seen that the metaphors "mother" and "tree" were the most frequently expressed. Considering the metaphor sources used by the participants regarding the concept of "science teacher" and the explanations/reasoning made for these metaphors, the metaphors were provided under the 10 categories given in Table 6 based on their common features.

Table 6. Categories formed based on the metaphors created by the participants regarding the concept of science teacher

Categories	Metaphor Sources	f	%	Related Quotes
1. Guidance	Guide (4), Key (2), Guidebook (2), Leader (1), Light (1), Painter (1), Compass (1), One who balances the precision scale (1), Sunlight (1)	14	25.0	"A science teacher is like a leader. They are the persons who direct students and lead them." S6 "A science teacher is like light. They lead the way to prepare us for bright futures." S8 "A science teacher is like a key, because they know which door to open." S15 "A science teacher is like a painter, they color the canvas (student) with the paint (information) they have." S26 "A science teacher is like a guidebook, because they explain something that is complex." S36
2.Knowledgeable in every topic	*Mother* (4),*Good instructor* (1), Very knowledgeable (1), Book (1), Intellect (1), Encyclopedia (1), Google(1)	10	17.8	"A science teacher is a mother, because they are knowledgeable in several fields/areas." S22 "A science teacher is a person who teaches well, because they have knowledge in every topic." S20 "A science teacher is like a book, because they are filled with information." S35
3. Researcher/ Inquisitive	Scientist (4), Researcher (3), Genius (2)	9	16.0	"A science teacher is like a researcher, because they question the universe and try to understand it." S32 "A science teacher is like a scientist, because they experiment, research and inquire in scope of science." S24 "A science teacher is like a genius, because they have the capacity to consider the smallest details." S16
4. Knows how to teach	*Good instructor* (3), Fun teacher (2) Like me (2), Computer teacher (1)	8	14.3	"A science teacher is a person who teaches well, they look at the outer world more meaningfully." S4 "A science teacher is like a fun educator, because although the course is boring, they teach the truth in a fun way with experiments." S7 "A science teacher is like me. They are the person who knows how to instruct without boring the student as I will do in the future." Ö12
5. Useful	Tree (5), Miner (1), Newton who discovered gravity (1)	7	12.5	"A science teacher is like a tree, because they are useful for both themselves and those around them." Ö2 "A science teacher is like the truth, because they teach the truth." S29
6. Basic need	Water (1), Father (1), Head of the household (1)	3	5.4	"A science teacher is like the father of a household, because they are the foundation of everything." S27 "A science teacher is like the head of a household, because without the head, that house's foundation will not be durable. Without the teacher, pieces of information are not durable." S48
7.Compassionate	*Mother* (2)	2	3.6	"A science teacher is like a mother, they are filled with compassion." S23
8. Challenges students	Steep hill (1)	1	1.8	"A science teacher is like a steep hill, because they challenge the student with the research and questions they provide." ÖS19
9. Productive	Engineer (1)	1	1.8	"A science teacher is like an engineer, because they can create novel things." S31
10.Makes life easier	Machine (1)	1	1.8	"A science teacher is like a machine, because they make our life easier." S42

*In Table 6, some metaphor sources are italicized because it is used in more than one category.

It is seen in the metaphors of the teacher candidates that they described a science teacher as guidance (25.0%), one who is knowledgeable in every topic (17.8%) and an individual who researches and questions (16%). Most metaphors produced on this concept were distributed under these categories. The sources of the metaphors produced by the teacher candidates regarding the concept of "science student" are given in Table 7.

Table 7. Sources of metaphors produced regarding the concept of science student

Source Name	f	%	Source Name	f	%	Source Name	f	%
Dough	6	11.0	Assistant	1	1.8	Hope of the future	1	1.8
Seed	4	7.3	Blank page	1	1.8	Inventor	1	1.8
Researcher	3	5.6	Clay	1	1.8	Ladle	1	1.8
Uninformed person	3	5.6	Coal in a mine	1	1.8	Like me	1	1.8
Worker	3	5.6	Diffraction of sunlight	1	1.8	Lucky person	1	1.8
Atom ant	2	3.6	Dollars	1	1.8	Offspring	1	1.8
Bee	2	3.6	Flower	1	1.8	Prisoner	1	1.8
Box	2	3.6	Grass	1	1.8	Race horse	1	1.8
Cassette	2	3.6	Guinea pig	1	1.8	Robot	1	1.8
Child	2	3.6	Happiness	1	1.8	Stomach	1	1.8
A nice/kind being	1	1.8	Hard disk	1	1.8	Storage area	1	1.8
Apple	1	1.8	Hardworking person	1	1.8	Test subject	1	1.8

As seen in Table 7, the teacher candidates produced 36 different metaphors. According to the table, it is seen that the metaphor "dough" was the most frequently expressed. Considering the metaphor sources used by the participants regarding the concept of "science student" and the explanations/reasoning made for these metaphors, the metaphors were provided under the 11 categories given in Table 8 based on their common features.

Table 8. Categories formed based on the metaphors created by the participants regarding the concept of science student

Categories	Metaphor Sources	f	%	Related Quotes
1. A valuable being	Apple (1), Flower (1), Coal in a mine (1), Offspring (1), Lucky person (1), Dollars (1), Grass (1), Hope of the future (1), Nice/Kind being (1), *Seed* (2)	11	20	"A student is like a flower, they need care while growing." S40 "A student is like coal in a mine, gains value as processed." S38 "A student is like one's offspring, they have a clean heart." S25 "A student is like a lucky person, because they learn a new thing every day." S21 "A student is like dollars, they gain value later." S16 "A student is like a kind being, they collect everything good on themselves." S6 "A student is like a seed, they are useful for those around them when they grow." S2
2. A hardworking being	Bee (2), Worker (3), Hardworking person (1), Atom ant (2)	8	14.5	"A student is like a bee. They need do constantly work within an order." S36 "A student is like a worker, because they work a lot." S28
3. Passive receiver of information	Stomach (1), Hard disk(1), Cassette (2), Ladle (1), Box (2), Storage area (1)	8	14.5	"A student is like a stomach which feels hunger, because they are hungry for knowledge and they want to be fed." S42 "A student is like a hard disk, their capacity for information is infinite." S39 "A student is like a cassette, they constantly record the information they receive." S30 "A student is like a ladle in a laboratory, because whatever you put onto a ladle, it is filled with that." S29 "A student is like a box, because however much information you load into a box that is how full it is." S35 "A student is like a storage area, because they are always loaded with input." S5
4. Raw Material	Dough (6), Clay (1),	7	12.8	"A student is like a dough, they are shaped as you shape them." S41 "A student is like clay, they take the shape of how you mend them." S26
5. An empty mind	Uninformed person (3), Child (1), Blank page (1)	5	9.1	"A student is like an uninformed person, because their knowledge increases as they learn." S1 "A student is like a child, because they are hungry for information." S23
6. Running being	Prisoner (1), Race horse (1), Robot(1), Test subject (1), Guinea pig (1)	5	9.1	"A student is like a prisoner, because they are always running." S43 "A student is like a race horse, because performance is always expected from them." S34 "A student is like a robot, because they have to follow a program." S33 "A student is like a test subject, because all kinds of systems are tried/applied on them." S27
7. Inquiring /				"A student is like a researcher, because they do research to learn

questioning being	Researcher (3), Inventor (1)	4	7.3	about things and receive education for it." S46 "A student is like an inventor, because they think of everything that does not run into the teacher's mind." S44
8. Genuine being	*Child* (1), Like me (1), Happiness (1)	3	5.5	"A student is like a child, because they like to play games." S37 "A student is like me, because they are curious and interested". S31 "A student is like happiness, because they always manage to make one feel good." S17
9.Developing being	*Seed* (2)	2	3.6	"A student is like a seed, because they develop and become mature." S32
10. Information reflector	Diffraction of sunlight (1)	1	1.8	"A student is like diffraction of sunlight, because they reflect the information they have received from the teacher like sunlight." S47
11.Helper	Assistant (1)	1	1.8	"A student is like an assistant, because they help in the class." S24

*In Table 8, some metaphor sources are italicized because it is used in more than one category.

The teacher candidates were observed to describe a science student as a valuable being (20%), a hardworking being (14.5%) and a passive receiver of information (14.5%) in their metaphors. In addition to this, it was also found that a student was seen by the teacher candidates as both a raw material (12.8%) and an empty mind (9.1%). Comprehensively looking at the findings of the study, it may be seen that the metaphors produced by the teacher candidates regarding the concepts subject to the study were not distributed into a common category. However, the metaphors developed towards the concepts of science course, laboratory and teacher had the common categories of "guidance", "making life easier" and "basic need". It is seen that the metaphors on the concepts of science teacher and student had the common category of "inquiring/questioning". The metaphors developed for the concepts of science course and laboratory had the common categories of "infinite", "curiosity-inspiring" and "entertaining".

Discussion and Conclusion

In this study where it was aimed to determine the perceptions of teacher candidates teachers on the concepts of science course, science laboratory, science teacher and science student through metaphors, the participants used around 30-35 source concepts and produced around 50-55 metaphors. In the light of the findings, it was observed that the source concepts used by the teacher candidates for targeted concepts varied.

The metaphors showed that the perceptions of the teacher candidates depended on perceptions; 1) that the sciences course concerns various fields, it is related to daily life, a new information will be obtained as a result of a personal experiences and obtaining information is a labored and time-consuming process, etc. in terms of the concept of science course; 2) on the experiments conducted in science laboratories, the contents and results of experiments and the materials in laboratories, etc. in terms of the concept of science laboratory; 3) on ability of teachers to guide their students, their knowledge in every field and their operation as a scientist, etc. in terms of the concept of science teacher, and 4) that the student is valuable, they constantly need information, they need the teacher in order to obtain information and they are in a constant rush like a race horse, etc. in terms of the concept of science student. The reason for this variety was interpreted as the capacity of the teacher candidates to create different metaphors towards the concepts of science course, science laboratory, science teacher and science student based on their own values, beliefs and philosophies. Saban, Koçbeker and Saban (2006) stated that metaphors may be used as strong mental tools to investigate and reveal the personal values, beliefs and philosophies of teacher candidates on phenomena such as learning and teaching. Investigating metaphorical images is a method that is used to reveal what lies under the beliefs and assumptions of teachers and teacher candidates on the roles they have in the classroom, the students, and education (Ben-Peretz, Mendelson and Kron, 2003).

While the metaphors produced by the teacher candidates for the concept of science course had variety, it was also found that the metaphor "life" (21.1%) was frequently expressed as a source concept. The finding that the concept "life" was the most frequently mentioned source concept among the teacher candidates shows that they perceived the sciences course as a course that concerns several fields, especially the societal, social and economic fields and contains a wide spectrum of subjects (Aktamış and Dönmez, 2016). For example, this situation is supported by the statement by S20 as: *"A science course is life, because we encounter examples from sciences in every step of life."* A study by Afacan (2011) found that the source concept that was the most frequently mentioned in the metaphors created by science teacher candidates towards the concept of science was the concept of "life". Similarly, Aktamış and Dönmez (2016) found that the metaphor sources that were the most frequently repeated ones among middle school students regarding the concept of science course were

"science", "life" and "experiment". In Demirci-Güler's (2012) study, it was determined that the concept "woman" was the most frequently used concept while creating metaphors regarding the course science and technology. Soysal and Afacan (2012) reported that the most frequently used concepts in metaphors created for the concept of science and technology course by primary education students were "book", "person", "computer", "water" and "science" in a descending order, most students likened the concept of a science and technology course" to structures that have multiple components such as "school, world and computer," and this association was caused by that the students perceived the science and technology course as a course that contains a very wide spectrum of subjects. In Çilingir's (2014) study, the most frequently mentioned concepts in metaphors for the concept of science were "boring" (19.4%) and "fun" (14.8%) for students in Sweden, and "life" (20.72%) and "science" (10.5%) for Turkish students.

The findings showed that the science teacher candidates perceived the concept of science course from various perspectives as "understanding/discovering life", "infinite", "curiosity-inspiring", "changing and developing", "enlightening/guiding", "basic need", "requires struggle", "entertaining" and "making life easier". It was also determined that the teacher candidates saw the sciences course mostly as understanding/discovering (26.3%) and infinite (21%). Afacan (2011) analyzed the metaphors created by science teacher candidates on the concept of science under 11 categories as "the life itself", "inclusive of different branches", "unknown/infinity", "area of inquiry", "lighting the way", "enlightening/reflective", "open to new inventions/inquisitive", "pleasant/entertaining", "containing hard-to-solve problems", "process" and "making life easier", and determined that teacher candidates perceived the concept of science most frequently as "the life itself". Aktamış and Dönmez (2016) analyzed metaphors developed by middle school students for the sciences course under 8 categories as "area of examination", "simple/fun", "necessary/important", "guidebook/evidence", "hard/difficult to understand", "accumulative progress/process" and "comprehensive/integrative", "repulsive/scary", and students perceived the sciences course most frequently as an "area of examination". Demirci-Güler (2012) analyzed metaphors developed by teacher candidates for the concept of science and technology under 6 categories as "difficulty of understanding science", "science as a method, process", "science exists whether we want it or not", "approaching science with prejudice", "science adding value on life" and "accumulative nature of science", and teacher candidates perceived the concept of science and technology most frequently in terms of "difficulty of understanding" it. Soysal and Afacan (2012) analyzed metaphors developed by primary education students for the concept of science and technology course under 14 categories as "inclusive of different branches", "informative", "area of investigation/research", "easy/entertaining", "the life itself", "necessary/important", "fluent", "comprehensiveness", "answer to the unknown", "lighting the way/guiding", "openness to new discoveries", "problems that are hard to solve", "permanent" and "enlightening/reflective", and the students perceived the concept of science and technology course most frequently as "inclusive of different branches". Çilingir (2014) analyzed metaphors developed by students in Sweden on the concept of science under 20 categories as "boring", "fun", "life", "nature", "collection of information", "discovery and learning new things", "experiment", "comprehensive", "positive attitude", "universe", "guide", "variable", "negative attitude", "reflects facts", "enchanting and exciting", "difficult", "logical", "an important part of our life", "only a course" and "incomprehensible", and students perceived the concept of science most frequently as "boring" (24.63%) and "entertaining" (16.42%). In the same study, metaphors of Turkish students were analyzed under 27 categories as "life", "science", "positive attitude", "fun", "teaches and enlightens", "difficult", "mathematics", "experiments", "a subject taught at school", "comprehensive", "complicated", "world", "guide", "requires intelligence", "collection of information", "nature", "one succeeds as they work", "invention", "fluent", "negative attitude", "need", "easy", "boring", "advances", "exciting", "assumption" and "temporary", and students perceived the concept of science most frequently as "life" (22.37%).

The science teacher candidates associated the sciences course more with the experiment and life source concepts in the "understanding/discovering life" category and life and space source concepts in the "infinite" category. The teacher candidates' predominant association of the sciences course with the concepts of experiment and life reveals the perception that new information will actually be gained as a result of a personal experience, and obtaining information is a process that requires effort and time. The participants' association of the sciences course with the concepts of life and space in the category they saw to be infinite reveals the perception that scientific developments are not stationary and new information is constantly obtained.

It may be stated that the positive perceptions of the teacher candidates on the sciences course (e.g. understanding and discovering life (26.3%), infinite (21%), curiosity-inspiring (12.3%), changing and developing (10.6%), enlightening/guiding (10.6%)) were much more dominant than their negative perceptions (e.g. requires struggle (7%)). Considering that the metaphors presented here were based on the personal experiences and interpretations of the science teacher candidates, the finding that the positive perceptions of the participants were more dominant may be interpreted as an indication that they will have more positive attitudes and images

regarding their profession in the future. Similarly, in metaphors developed by middle school students (Aktamış and Dönmez, 2016) towards the sciences course, it was found that their positive perceptions (e.g. guidebook/evidence, simple/pleasant, necessary/important) were more dominant than their negative perceptions (e.g. difficulty/problem in understanding, repulsive/scary). It was also seen in Afacan's (2011) study that the positive perceptions of science teacher candidates on the concept of science were more dominant in comparison to their negative perceptions. Güler's (2012) study, on the other hand, found that the negative perceptions of teacher candidates on the concept of science and technology were more dominant in comparison to their positive perceptions. Soysal and Afacan (2012) showed that the positive perceptions of primary education students on the concept of science and technology course were more dominant in comparison to their negative perceptions. Çilingir (2014) reported that students in Sweden had more dominant negative perceptions such as that sciences do not contain fun subject, classes are not entertaining, and they do not like sciences, while most Turkish students presented more dominant positive perceptions such as that sciences are intertwined with life, they teach us about life and they have an important part in our lives.

Considering the metaphors produced by the teacher candidates on the sciences course, it is seen that the similarities they pointed out were especially on the importance and necessity of the sciences course (e.g. understanding and discovering life (26.3), enlightening/guiding (10.6%), basic need (7%)). While the sciences course is among the courses that are found difficult to understand and succeed in due to its abstract and complex structure (Akdeniz, Ayas and Çepni, 1994; Aksoy and Doymuş, 2011; Hançer, Şensoy and Yıldırım, 2003), it was seen that the science teacher candidates who perceived the course as difficult were only a few (e.g. requires struggle (7%). This may be considered as a result of teacher candidates seeing science courses as important, necessary and fun courses that require personal effort instead of a course that is difficult, due to laboratory applications and activities in the classroom. For example, this situation is supported by the statement byS33:*"A science course is like an experiment, because as a result of the experiment, we always learn something new."* As it is known, it is possible for students to learn the scientific concepts or topics that they find it difficult to understand more easily with the help of laboratory applications where learning takes place by doing or experiencing (Çallıca, Erol, Aygün, Sezgin and Kavcar, 2000; Kurt, 2003; Hofstein and Lunetta, 2004; Kocakülah and Savaş, 2011).

While the metaphors produced by the participants regarding the concept of science laboratory varied, it was seen that the concept "fun" (13.0%) was the most frequently mentioned source concept, and concepts such as "playground, instructive party, and puzzle" were also frequently mentioned. The metaphors containing these source concepts included sentences suggesting that experiments in a science laboratory are fun. For example, this is supported by the statement by S44: "*A laboratory is like fun, because I have fun while conducting an experiment.*" The reason for this may be that the concept of a laboratory is perceived as fun by teacher candidates as the classes are held in a more entertaining way with the experiments and activities in the laboratory environment. Arık and Özdemir (2016) reported that the most frequently mentioned source concept about the concept of a science laboratory by science and technology teacher candidates was "kitchen" (33%). Likewise, Yücel-Cengiz (2016) stated that the most frequently mentioned source concept about the concept of laboratory by biology teacher candidates was also "kitchen" (17.05%). Bağ and Küçük found that the most frequently mentioned source concepts for the concept of a science laboratory by teacher candidates were "hospital" (26.7%) and "kitchen" (14.9%).

The metaphors produced by the science teacher candidates for the concept of science laboratory were analyzed under 12 categories as "place where experience is gained", "entertaining", "way to reach information", "creative setting", "materials depot", "infinite", "boring place", "curiosity-inspiring place", "making life easier", "limited"- "basic need" and "guiding", and it was seen that the teacher candidates saw a science laboratory most frequently as a "place where experience is gained" (22.7%), "entertaining" (22.7%) and "way to reach information" (15.1%). Arık and Özdemir (2016) analyzed metaphors of science and technology teacher candidates on the concept of science laboratory under 9 categories as "science laboratory by function", "science laboratory in a negative sense, "place of discovery and new product production", "place of learning by doing and experiencing", "science laboratory by physical equipment", "place that prepares for daily life", "fun place", "place of prescription-type experiments" and "place of learning and gaining information", and teacher candidates most frequently perceived the concept of science laboratory as "a science laboratory by function" (25%). Bağ and Küçük (2017) analyzed metaphors on the concept of science laboratory created by teacher candidates under 7 categories as "cold-unwanted setting", "production center", "reaching subjective information", "scientific study", "expensive setting", "source of information" and "being able to work in various fields". In the study, teacher candidates most frequently perceived the concept as a "cold-unwanted setting" (44.3%) and the most frequently used source concept in this category was "hospital". Yücel-Cengiz (2016) analyzed metaphors by biology teacher candidates on the concept of laboratory under 14 categories as "tools-

equipment", "production place", "waiting to be discovered", "from the piece to the whole", "comprehensive", "indispensable", "teaching by entertainment", "requiring attention and care", "has rule", "requiring patience", "systematic", "visualizing", "complex", "needs to be complete", and participants perceived the concept of science laboratory most frequently as "tools-equipment" (14.77%).

It was seen in this study that the positive perceptions of the science teacher candidates (e.g. place where experience is gained, entertaining, way to reach information) were more dominant than their negative perceptions (e.g. materials depot, boring place, limited). Considering the target and source concept relationships of the presented metaphors, the finding that the participants' positive perceptions were more dominant may be explained by entertaining experiment contents and that they gain knowledge and experience with the experiments they conduct while having fun. Additionally, considering the reasoning of the metaphors in the category "way to reach information" (15.1%), this situation was interpreted as that the teacher candidates perceived science laboratories not only as a place where experimental operations are followed based on given steps, but also as a place where new information is revealed. For example, S38:*"A laboratory is like turning coal into gold, because we sometimes try to reach the results we know, but sometimes we try to reach the unknown.*" Arık and Özdemir (2016) reported that 88% of metaphors created by science and technology teacher candidates on the concept of science laboratory are positive, and the reasons for this are focused on entertaining laboratory classes and their contribution on participant's learning and attitudes; other metaphors are negative (%12), and the reason for this is focused on the length of the class and the content of the experiment. Bağ and Küçük (2017) reported that the negative perceptions of teacher candidates on the concept of science laboratory (cold-unwanted setting, etc.) are more dominant, in other words, participants have rather negative images on the physical structure of science laboratories, and this might be because some materials such as injectors, gloves and some chemicals used in hospitals are also used in laboratories. Yücel-Cengiz (2016) found that biology teacher candidates have mostly positive views on the concept of laboratory.

While the metaphors produced by the participants regarding the concept of science teacher varied,it was seen that the source concepts of "mother" and "tree" were the most frequently mentioned concept. As to the reason for choosing these concepts, sentences were used in relation to science teachers knowledgeable in every topic and useful for the ones around them. Examples would be the statements by S22: "*A science teacher is like a mother, because they are knowledgeable in several fields/topics"* and by S2: "*A science teacher is like a tree, because they are useful for both themselves and others around them.*" This was interpreted as the teacher candidates' perception of science teachers as knowledgeable and useful. Similarly, Afacan (2011) stated that science teacher candidates used the source concept "scientist" (17.2%) the most frequently regarding the concept of science and technology teacher and science teachers were regarded to be knowledgeable in all fields. Soysal and Afacan (2012) reported that the source concepts of metaphors created by primary education students on the concept of science and technology teacher were "scientist" (10.21%), "doctor" (9.48%) and "book" (9.48%). Aktamış and Dönmez (2016) found that middle school students utilized the source concepts of "angel", "scientist", "mother" and book" most frequently in their metaphors regarding the concept of science teacher. Çilingir (2014) determined that the most frequently utilized source concepts for metaphors on the concept of science teacher were "a good teacher" (28.85%) and "an intelligent teacher" (12.5%) for students in Sweden, and "angel" (14.81%) and "a good person (13.7%) for Turkish students.

The metaphors produced by the science teacher candidates for the concept of science teacher were analyzed under 10 categories as "guidance", "knowledgeable in every topic", "questioning/inquisitive", "knows how to teach", "useful", "basic need", "compassionate", "challenges students", "productive" and "making life easier", and it was found that the participants associated the concept of science teacher most frequently with the concepts in the categories "guiding" (25%), "knowledgeable in every topic" (17.8%) and "questioning/inquisitive" (16%). Afacan (2011) analyzed metaphors produced by science teacher candidates on the concept of science and technology teacher under 7 categories as "guiding-directing", "knowledgeable in every topic", "scientist-researcher", "information provider", "shaper", "supporter of individual development" and "in terms of personality traits", and found that participants perceived the concept of science teacher most frequently as "knowledgeable in every topic" (23.6%), "in terms of personality traits" (23.6%) and "scientist-researcher" (22.6). Soysal and Afacan (2012) analyzed metaphors produced by primary education students on the concept on science and technology teacher under 10 categories as "form of transferring information", "information provider", "knowledgeable in every topic", "personality traits", "scientists/researcher", "guide/director", "supportive of individual development", "reflective", "shaping" and "necessary/important", and determined the students perceived the concept of science teacher most frequently as "form of transferring information" (22.62%), "information provider" (22.62%) and "knowledgeable in every topic (18.24%). Aktamış and Dönmez (2016) analyzed metaphors produced by middle school students on the concept of science teacher under 6 categories as "personality traits", "supportive of individual development", "necessary/important",

"knowledgeable", "reflective/enlightening" and "form of transferring knowledge" and found that science teachers were seen most frequently as "knowledgeable", "in terms of their personality traits" and "reflective/enlightening". Çilingir (2014) analyzed metaphors developed by students in Sweden on the concept of science teacher under 12 categories as "intelligent", "happy and fun", "teaches information", "a good teacher", "negative attitude", "boring", "guiding", "wise", "only a teacher", "helpful", "a significant part of our lives" and "other", and observed that science teachers were seen most frequently as "intelligent" (16.35%), "happy and fun" (15.38%), "teaching information" (12.5%). In the same study, metaphors by Turkish students on the concept of science teacher were analyzed under 21 categories as "a good person", "teaches information", "wise", "instructs well", "enlightens and guides", "negative attitude", "patient", "intelligent", "fun", "helps us", "hardworking", "life", "tells us what to do", "inventor", "happy", "love their job", "has comprehensive knowledge", "a significant part of our lives", "natural scientist", "only a teacher" and "other", it was determined that science teachers were seen most frequently as "good people" (40.37%) and "teaching information" (10.74%).

It was seen that the positive perceptions of the science teacher candidates on the concept of science teacher (e.g. guiding, knowledgeable in every topic, questioning/inquisitive) were highly dominant against their negative perceptions (e.g. challenging students). The participants' perceptions as "guiding" (25%) may be related to associating science teachers as guides. Additionally, the participants' perceptions of a science teacher to be "knowledgeable in every topic" (17.8%) may be explained by science teachers' ability to answer all kinds of questions by the teacher candidates and persuade them with their responses. For example, S22: "*A science teacher is like a mother, because they are knowledgeable in several fields/topics"* and Ö20: *A science teacher is a person who teaches well, because they have knowledge on every topic"*. Afacan (2011) found that the perceptions of e science teacher candidates on the concept of science and technology teacher were generally positive. Soysal and Afacan (2012) determined that the positive perceptions of primary education students on the concept of science and technology teacher were more dominant. Aktamış and Dönmez (2016) reported that perceptions towards the concept of science teacher were generally positive, while 5th and 6thgrade students had more positive perceptions than 7th and 8thgrade students.

While the metaphors created by the science teacher candidates on the concept of science student varied, the source concept "dough" (11%) was the most frequently mentioned concept. Considering the reasons for the metaphors, the sentences used by the participants included those like that a sciences student constantly needs information and requires the teacher to reach information. For example, S42:*"A student is like a stomach feeling hunger, because they are hungry for information and they want to be fed"* andÖ44:"*A student is like dough, because they take the shape you give them."* These statements were interpreted as perception of science students as passive receivers of information. This is similar to the results of the study by Aydın and Pehlivan (2010). While there are several studies that investigated metaphors produced for different concepts (education, science, school, classroom, teacher, life sciences and technology, etc.), it was found that studies on metaphors related to the concept of student (Aydın and Pehlivan, 2010; Saban, 2009; Sezgin, Koşar, Koşar and Er, 2017) were limited in the national literature, and no study was found on the concept of science student. In Aydın and Pehlivan's (2010) study, the metaphors that were formed by teacher candidates of Turkish with the source concepts of "seed" (5.1%), "sapling" (4.3%) and "flower" (4.3%) were the most frequently used metaphors. In Saban's (2009) study, the metaphors that were formed by teacher candidates studying in different programs in the Faculty of Education with the source concepts of "sapling" (12.7%), "flower" (8.4%), "dough" (7.3%), "blank page" (4.8%) and "seed" (4.5%) were the most frequently used metaphors. In Sezgin, Koşar, Koşar and Er's (2017) study, metaphors of teachers who were employed at primary education institutions regarding the concept of student frequently included the source concepts of "flower", "dough/clay" and "tree/sapling". In Çırak's (2014) study, in metaphors developed on the concept of student by middle school teachers, the source concepts of "dough" (12.5%) and "mirror" (9.6%) were used the most frequently.

The metaphors developed by the science teacher candidates for the concept of science student were analyzed under 11 categories as "a valuable being", "a hardworking being", "passive receiver of information", "raw material", "an empty mind", "a running being", "a questioning/inquiring being", "a genuine being", "a developing being", "reflector of information" and "assistant", and it was determined in this study that the participant perceived the concept of science student most frequently as "a valuable being" (20%), "a hardworking being" (14.5%), "passive receiver of information" (14.5%), "raw material" (12.8%) and "an empty mind" (9.1%). Aydın and Pehlivan (2010) analyzed metaphors developed by teacher candidates of Turkish on the concept of student under 5 categories as "receiver of information", "one that is produced and shaped", "reflector", "one who spends effort" and "one that is restricted", and the concept of student was seen most frequently as "the one that is produced and shaped" (47%) and "receiver of information" (37%). Saban (2009) analyzed metaphors produced by teacher candidates regarding the concept of student under 11 categories as "an

empty mind", "passive receiver of information", "information reflector", "raw material", "a disabled being", "a submissive being", "social capital", "a valuable being", "a developing being", "builder of own knowledge" and "social participant", and found that the concept of student was seen generally as "a developing being" (29.6%), "raw material" (22.6%) and "an empty mind" (18.5%). Sezgin, Koşar, Koşar and Er (2017) analyzed metaphors produced by primary education teachers on the concept of student under 9 categories as "a developing being", "a valuable being", "raw material", "information reflector", "an empty mind", "social participant", "a genuine being", "passive receiver of information" and "negative association", and they observed that the most frequently mentioned categories were "student as a developing being" (25.5%) and "student as raw material" (25.2%). Çırak (2014) analyzed metaphors created by middle school teachers regarding the concept of student under 8 categories as "an information-receiving being", "a being that is produced and shaped", "a reflective being", "a being that spends effort", "a being that is restricted", "a valuable being", "a being without a purpose" and "a being that should be guided", and found that 36% of teachers as the student as a being that is to be "produced/shaped". Inbar's (1996) study with, 409 students and 254 educators analyzed metaphors developed by educators on the concept of student under 8 categories as "flora and fauna", "nice and kind", "receptacle", "clay in the potter's hand", "captive student", "rebellion", "programmed independence" and "small and lonely", and the prominent categories were "flora and fauna" (27.2%)", "nice and kind" (26.9%)and "receptacle" (17.6%). In the same study, metaphors developed towards the concept of student by students were also analyzed under the 8 categories mentioned above, and the prominent categories were "captive student" (33.2%), "nice and kind" (24.9%) and "programmed independence" (15.6%).

While the positive perceptions of the science teacher candidates regarding the concept of science student (e.g. a valuable being, a hardworking being, a questioning/inquiring being) were dominant against their negative perceptions (e.g. passive receiver of information, an empty mind, a running being), it was seen that the negative perceptions of the teacher candidates (uninformed person, prisoner, guinea pig, etc.) were on a level that cannot be neglected. It is believed that the negative perceptions of teacher candidates on science students were caused by perceiving themselves negatively and the roles cast upon them by their teachers in their pre-undergraduate and undergraduate processes. For example, S21: "*A student is like an uninformed person, because their knowledge increases as they learn*" and S43: "*A student is like a prisoner, because they are always running*". Sezgin, Koşar, Koşar and Er (2017) found that the vast majority of metaphors produced by teachers on the concept of student had positive association, and approximately 15% of metaphors were those with negative associations based on concepts that suggest limitations of learning and development capacities of students. Çırak (2014) determined that teachers working at schools in high socioeconomic status environments perceived students more positively and attributed student success to themselves, while teachers working at schools in low socioeconomic status environments perceived students more negatively and emphasized the importance of family in development of students.

The concepts of science course, science laboratory, science teacher, and science student are intertwined with each other. Similarly, in many categories of the teacher candidates' perceptions seems to be related to each other. It is pleased that the teacher candidates are often produce positive metaphors for the concepts of science course, science laboratory, science teacher, and science student. It can be said that the situation of having positive metaphors may be the result of the positive attitudes of teacher candidates towards these concepts. The perceptions and attitudes of teacher candidates for these concepts will be affect their behavior toward their students, their interaction with students, and the teaching methods and techniques they choose in the future. Also, using the data obtained through the metaphors which developed for the concepts of science course and science laboratory by teacher candidates, it can be provided that the teaching processes for these courses can be rearranged and organized more interesting. The findings obtained in the study provide important evidence that metaphors may be used as a strong tool to determine the views of science teacher candidates on the concepts of "science course, science laboratory, science teacher and science student". Likewise, Saban (2009) stated that metaphors may be used as strong research tools in understanding, revealing and explaining the mental images of individuals regarding a phenomenon. However, it is recommended to use different research methods, and reveal the relationship among these concepts in teacher candidates' understanding on them in a clearer sense.

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