academicJournals

Vol. 10(2), pp. 161-176, 23 January, 2015
DOI:10.5897/ERR2014.1997
Article Number: 8BA469049760
ISSN 1990-3839

http://www.academicjournals.org/ERR

Educational Research and Reviews

Full Length Research Paper

Prospective teachers' metaphorical perceptions on the concept of science

Derman Aysegul[1*] and Derman Serdar[2]

[1]Classroom Teaching Department, Nizip Faculty of Education, Gaziantep University, Turkey.
[2]Turkish Teaching Department, Faculty of Education, Gaziantep University, Turkey.

Received 17 November, 2014; Accepted 6 January, 2015

The aim of this study is to reveal prospective teachers' perceptions of the concept of science by asking them to use metaphors to describe it. A metaphor elicitation method was employed in this study. The data obtained from the study were considered with both quantitative and qualitative (Content Analysis) analyses. The study determined the metaphors used to express the concept of science by prospective teachers, and then these metaphors were thematised by categorising their common properties. Nine different conceptual categories were determined, including "*Science as synthesis of scientific knowledge*", "*science as a benefit provider*" and "*science as a basic requirement*" etc. Prospective teachers' metaphorical perceptions present indicators about their perspectives on science and the nature of science.

Key words: Science education, metaphors, nature of science, prospective classroom teachers, prospective science teachers, scientific literacy, teaching, worldview

INTRODUCTION

"Human beings are constantly attempting to develop conceptions about the world, and they do so symbolically, attempting to make the world concrete by giving it form. Through language, science, art, and myth, for example, humans structure their world in meaningful ways. These attempts to objectify a reality embody subjective intentions in the meanings that underwrite the symbolic constructs that are used. Knowledge and understanding of the world are not given to human beings by external events; humans attempt to objectify the world through means of essentially subjective processes" (Morgan, 1980, p. 6).

The use of metaphor is not only associated with daily language, but also associated with literature and poetry (Lakoff and Johnson, 2005). Beyond being an artful decoration to daily language, metaphors have much more fundamental functions (Saban, 2004). Although metaphors often play an important role in our daily life, we are not fully aware of them, or we do not think deeply about the meaning of the ones we notice (Lakoff and Johnson, 2005). Oxford et al. (1998) interpret metaphor as a concept or a phenomenon, explaining a given situation by likening it to another concept, phenomenon or situation. The essence of metaphor is, fundamentally, understanding and experiencing one kind of thing in terms of another (Lakoff and Johnson, 2005, p.27).

*Corresponding author. E-mail: aderman1977@gmail.com.

Lakoff and Johnson explain their concept of metaphorical systematicity as allowing us to comprehend one aspect of a concept (A) in terms of another (B) which will necessarily hide other aspects of this concept. While metaphorical concepts give us the opportunity to focus on an aspect of a phenomenon, they do so by sending away us from relying on other aspects that may be incompatible with this metaphor. For example, Morgan (1998) uses eight different metaphors (prison of souls; organism and living systems; political system; the brain; the machine; culture; domination tools; and flowing and transformation) to describe the structure of organisations. While Morgan takes up a certain perspective of organisations with each of these metaphors, he necessarily also hides others. Thus, the structure of the organisations has been described powerfully, with eight different mental schemas.

And also Forceville (2002) refers to the three basic components of metaphor. These are the source of metaphor, the subject of metaphor and the features that will be transferred from the source of metaphor to the subject of metaphor. According to Lakoff and Johnson's Metaphor Theory, metaphors are conceptual structures giving direction to realising life and universe, to the ideas, to all behaviours, and to the style of finding the way in the world. Metaphorically structured concepts penetrate our perceptions, style of thinking, behaviours (Strenski, 1989) and the style of interpersonal communication, and constitute a fleeting glimpse of the universe (Morgan, 1980). Perry (2011) noted that one significant thing to realize about *Metaphor Theory* is that it is not about language use alone, but rather what language use reveals about cognition. Langacker (2008) describes metaphors as “a primary way of enhancing and even constructing our mental world” (in Perry, 2011, p.10). Basing on this description, Perry (2011) further explains metaphor theory as follows:

The weak version of the theory is that metaphors are used to give further definition to concepts already held. However, the strong version of the theory is that metaphor is the basis for abstract thought. The implications of this are quite large as it implies that the entire human mental world is metaphorical in nature (p.11).

Not only are the concepts related to daily life and scientific issues but also the concept of science itself is seriously abstract, symbolic, so metaphors help us explain these abstract concepts. Metaphor and analogy play significant roles in the development of new scientific theories (Niebert et al., 2012), where for example, Kepler developed his theories of planetary motion by using the mechanical watch as a metaphorical tool. Watson and Crick likewise relied on metaphor when announcing the double helix structure of DNA in the analogical model of a twisted ladder.

According to Uskokovic (2009), although the use of metaphorical causality is strongly rejected in many fields of science, literary gaps, namely misinterpretation, will occur in scientific communication if not used. Uskokovic (2009) explains this situation as follows:

Not only picturesque representations of molecules, atoms and subatomic “particles,” but the very mathematical concepts that underlie the postulated principles of physics present metaphors of the “modeled” experiential reality. Besides their evident significance in rational processes of developing novel scientific ideas and concepts, metaphorical leaps between logically disconnected (or at least unforeseeably connected) levels of conceptualization are, nevertheless, regularly regarded as intolerable mistakes in the realm of scientific reasoning (p. 249).

The role of metaphors is important in understanding the symbolic structure of scientific theory. The basic mode of symbolism is metaphorical process of conceptualisation and this process is in the center of the knowledge and experiences of the human being associated with the world. In the comparison between the images A and B in the metaphorical relationship, the prompt “A is B” or “A is like B” plays an important role in generating new meaning to the concept in hand (Black, 1962 cited in Morgan, 1980).

Using metaphor in education

Since metaphors provide a certain convenience in the explanation and appreciation of abstract concepts, facts and events, this has attracted the attention of educators. The principles of *from known to unknown, from concrete to abstract, from near to far* are among the main principles of teaching process. Concrete subjects have to be used in the teaching of abstract subjects. Since concrete information provides easy to picture ideas and creates images for students to interact with, it can more easily and correctly be interpreted and remembered than purely abstract information. For this reason, regardless of the level of the student, the scope of the new information has to be concretised as much as possible by using images, tables, graphics and simulations (Sünbül, 2010). In understanding metaphor, Botha (2009) points out the principal roles of changes in paradigm shift from objectivism to pluralism and relativism in education. She argues that these shifts are also reflected in teaching methodology and affirm themselves at various grades of the education process. Consequently, an assumption of a relationship between the main philosophical supposition and pedagogy emerges (p. 432). As well as being a good teaching technique for presenting new information, metaphors also assist memorisation. Students bind new information to old ones by carrying new information on an existing mental framework (schema), through metaphor. If a complete overlap is provided by establishing strong links between new and old information, the quality of the teaching process improves (Arslan and Bayrakçı, 2006, p.103). Yob (2003) has suggested that metaphors are strong mental tools used to understand and explain a highly abstract, complex and theoretical phenomenon. The use of metaphor in teaching should not be considered as a limitation to teaching with that metaphor, rather, it should be considered as enrichment of teaching methods by the use of different perspectives and comparisons (Saban, 2009).

The power of metaphors in explaining abstract concepts shows that they can be used in determining the perceptions, perspectives and attitudes of the individuals about different cases in educational research (Saban, 2004). In recent years, the studies aim at revealing the metaphorical perceptions of different facts remarkably increased in the field of educational research. Specifically, studies have been conducted on the use of metaphors to determine the perceptions of the individuals about some concepts such as teachers (Cerit, 2006; Saban, 2004); schools (Saban, 2008); students (Saban, 2009); inspectorship (Döş, 2010); environment (Ateş and Karatepe, 2013); mathematics (Bahadır and Özdemir, 2012; Oflaz, 2011) science (Buaraphan 2011; Niebert et al., 2012; Uskokovic, 2009) and chemistry (Jeppsson et al., 2013; Thomas and McRobbie, 1999).

The role of the comprehending concept of science or nature of science (NOS) in science education

The significant role of comprehending the concept of science and NOS in the context of learning and teaching science was realized by educators in the beginning of the last century. The NOS has been explained by many scholars as a form of knowing, the epistemology of science, the values and beliefs inherent to the evolution of scientific knowledge (Abd-El Khalick et al., 1998; Abd-El Khalick and Lederman, 2000). Philosophers of science, historians of science, and science educators did not reach a consensus on a specific definition of NOS (Abd-El Khalick and Lederman, 2000). As Abd-El Khalick and Lederman (2000) assert, this disagreement on NOS can be explained with the complicated and dynamic features of scientific efforts. However, science educators tried to determine and define some specific themes such as scientific observation, theory and law, imagination and creativity in scientific knowledge, socio-cultural values vice versa, and they proposed those themes as a frame to guide for further research (Lederman et al., 2002).

Driver at al. (1996) pointed out that understanding the nature of science promotes conceptual learning. Some research presents the relationship between these variables. For example, Tsai (1998) found a significant correlation between students' epistemological beliefs and learning styles. In another study, Shapiro (1989 in Driver et al., 1996) found that students' learning progress about light concept correlated to their comprehension of the concept of science.

Developed countries pay attention to grow their citizens as scientific literate individuals to adapt to rapid advances in science and technology and to provide required manpower (Lederman, 1992; Çepni et al., 2006; Hurd, 1998). The nature and teaching of science, scientific literacy which are the rising trend nowadays have a different importance for primary school teachers and teacher candidates. In such a way that; an individual firstly encounters with planned and programmed science in the institutions where s/he began education-teaching. During this education process, the individual begins to gain scientific knowledge, scientific process skills and scientific attitudes (Çepni et al., 2006, p. 40). The vision of the Science and Technology Lesson which was initiated in 2004 as a pilot program in Turkey is to develop the literacy of science and technology and for this purpose regardless of the cultural and individual differences to ensure all students become science and technology literate (Ministry of Education [MEB], 2004). At these dimensions the nature of science, scientific process skills and values constitute the essence of science appears repeatedly. The understanding of the nature of science (NOS) is one of the components found in the center of scientific literacy (American Association for the Advancement of Science [AAAS], 1990). Of course accomplishment of curriculum has a significant role in reaching the goals of education. Teachers have a vital role in carrying curriculum successfully. The perceptions, attitude and perspectives of teachers associated with science affect deeply qualification of science education.

Although there are studies which advocate that students understand the nature of the science easily by scientific research and investigation performance (Lederman and Niess, 1997), it is assumed that teachers reflect their perception, knowledge and beliefs on their teaching programme and practices (Turgut, 2009); and perceptions, perspectives and attitudes of prospective teachers are important to this embedded assumption. Turgut has revealed that prospective science teachers handle the concepts of hypothesis, theory and law in a strict hierarchical structure, where they considered laws as proven, precise and irrefutable structures, and they have not any valid perception about scientific theories and laws. Gürses et al. (2005) conducted a study with prospective chemistry teachers and prospective classroom teachers about their views related to the nature of science. They found that prospective teachers had some misconceptions related to scientific theory, proof and law. They concluded that not understanding the nature of science obstructs accepting and using modern scientific theories.

According to Aslan et al. (2009); Turkish science and technology teachers are insufficient and lack view related to description of the concept of science, nature of scientific observation, construction of scientific proposal, theory, law and method. The majority of these teachers have one realistic point of view about changability of scientific knowledge.

This study focuses on determining the perceptions and perspectives of prospective classroom teachers (PCTs) and science teachers (PSTs) about the concept of science by asking them to use metaphors related to this concept.

Aim of the study

The aim of the present study was to reveal the mental frameworks (in terms of images) of prospective classroom and science teachers, through analysing operative metaphors they use for interpretation. Within the scope of this aim, the answers of the following research questions are sought: RQ1- What are the common features of metaphors used by prospective classroom and science teachers, and under which categories can they be classified? RQ2- Is there a significant relationship between conceptual categories and the departments of prospective teachers? RQ3- Do metaphorical perceptions present indicators about PCTs and PSTs' perspectives on science?

Participants

The current study was carried out with 142 PCTs (undergraduate- non major science students) enrolled in Classroom Teaching Department of Elementary Teaching at Faculty of Education, Gaziantep University and 111 PSTs (undergraduate- major science students) enrolled in Science Teaching Department of Elementary Teaching at Faculty of Education, Necmettin Erbakan University and Gazi University during 2011-2012 academic year. 56.1%(142) of the participants were attending the department of classroom teaching programme (CTP) and 43.9% (111) of the participants were attending the department of science teaching programme (STP). The PSTs and PCTs were both included in this study because when they begin their profession the PCTs are supposed to teach science at entry level in grade 1, 2, 3 and 4; the PSTs are also supposed to teach science in grade 5, 6, 7, 8 in elementary school in Turkey.

Data collection

To reveal the perceptions of prospective teachers through metaphors, they were asked to complete the following prompt: "*Science is like …; because …* " within about a regular course period (45 min). Participants were asked to express their thoughts so as to focus on only one metaphor in the formulation of their response. In addition, at the top of the form given to the PTs, a short explanatory paragraph about metaphor and an example from other fields were provided in order to make the meaning clear and trigger their opinions. In studies which focus on metaphors (Saban, 2008; 2009; Cerit, 2006), it is seen that the word "*like*" generally demonstrates the link between the subject and the source of the metaphor more clearly. In this study the word "*because*" is used to obtain a more coherent description (Saban, 2008; 2009).

Data analyses and interpretation

Metaphor elicitation method (Seferoğlu et al., 2009) was employed in this study and content analysis was used for data analysis. The stages used in this study were constructed by investigating other relevant studies (Ateş and Karatepe, 2013; Cerit, 2006; Saban, 2004; 2008; 2009; 2011), and without skipping any of the stages by reporting all processes during the analysis elaborately. The analyses of the metaphors were carried out in the following stages:

Elimination and naming stage

At this stage, metaphors developed by PTs were transferred to the computer. As a conventional step in metaphor elicitation process, a temporary metaphor list was created in an alphabetical order. Researchers paid attention to the writings of the PTs whether or not they were focused on a certain metaphorical image during the creation of the list. The papers without any metaphor, those containing more than one and those that were left empty, were eliminated during this stage.

For example, there are two different metaphors (*bridge and ship*) in the following expression of metaphor: "*science is like bridges and ships, because when a river, lake or anything else like this comes up, it acts as a bridge and carries us safely to opposite side*". Although the reasons presented in this expression are valid, it was nonetheless eliminated due to the fact that it contained more than one metaphor.

Another example excluded from the scope of research was the case where a participant expressed that: "*science is like the sun, because it is necessary for the whole world. Science is like water, because everyone needs it. Science is like food, because living things do not resist their own hunger*"; the participant expressed his/her perception about science using more than one metaphor. This expression contains three different metaphors; *sun, water and food*. Since more than one metaphor was used, this paper was excluded from the research. 49 papers were excluded from the study because of the given reasons such as having more than one metaphor or not giving the explanatory sentence starting with "because" or having no relation between metaphor and the explanation.

Coding and metaphor determining stage

After the elimination and naming stage, a new metaphor list was created in an alphabetical order by using the valid metaphors within the scope of the study, then each metaphor (*tree, child, light, sun, human, life, etc.*) was named by coding. Thus, 106 valid metaphors were determined. A sample metaphor expression was determined for each metaphor that was believed to represent the concept best by rereading the papers including the coded metaphors. A sample metaphor list was created with the compiled metaphor expressions. It was expected that this list increased the validity of the process of analysis and it would contribute to determine categories functioning as an application source (Saban, 2009). Furthermore, in transferring the metaphor expressions stated by the participants, most expressions were transferred originally, but for very long expressions, abbreviations were created. Three dots were used to indicate any abbreviations in transferring metaphor expressions (Saban, 2009, p. 286). The information about the metaphorical expressions was given in parentheses by abbreviations of the numbers given to each student. Samples of these metaphors were presented in categories in the results section.

Category development stage

An inductive thematic content analysis was applied to categorize the metaphors. At this stage, the metaphors were considered according to their common traits. In this consideration, attention was paid to the features focused on by the participants, and the way in which they develop a perspective about the concept of science. The metaphors developed by the PTs were considered according to the relationship between the subject and the source of the metaphor. Each metaphor was included in a category by considering the perspective of the metaphorical expression of PTs. Thus, nine different conceptual categories and their sub-categories (Appendix A) were developed by authors.

Data transferring to SPSS package program and data analyse stage

The present study was conducted within a mixed design in nature, so SPSS programme was used in order to analyze the frequency and percentages of each metaphor, and categorizing and determining the relation between conceptual categories and the departments (Saban, 2008; Saban, 2011). After the determination of 106 valid metaphors and nine different conceptual categories, data were coded and transferred to SPSS package programme. Frequency and percentages were calculated for each metaphor and category. A Chi-Square test was applied to detect the way in which conceptual categories changed, according to the participants' departments.

Validity and reliability stage

The most important criticism to qualitative research is about reliability. It is not possible to mention validity and reliability in qualitative research in the same way in quantitative research, but some precautions for increasing validity and reliability can be taken in qualitative research. Detailed report of the collected data explaining how the researchers reach the results are among the important criteria in a qualitative research (Yıldırım and Şimşek, 2005, p.257). Thus, the analysis involved both quantitative and qualitative analysis techniques. Qualitative studies including more than one researcher are more acceptable and the internal reliability of these studies is higher (Yıldırım and Şimşek, 2005). All steps of this study were carried out with compromises on individual analyses of the researchers. For example, one of the researchers in this study included the "*infinite ladder*" metaphor, indicating "*science as a cumulative structure*", while another researcher included the same metaphor to describe "*science as an infinite structure*". Both researchers agreed on putting this metaphor under the category "*science as an infinite structure*".

In this study, expert opinion was consulted. A consideration meeting was done with a language teaching expert familiar with the paradigm of qualitative research. The research process was transferred entirely to the expert verbally. All the papers included the expressions of 106 metaphors and the titles of nine different categories, and the list of the sub-codes of these categories were given to the expert where it was requested that each metaphor be matched with a category. With comparison of the matching of the expert and the research, the number of the metaphors was detected.

The reliability of the research was calculated by using *Miles and Huberman's* reliability formula, namely: *Reliability = (number of agreements/total number of agreements + disagreements) × 100* (Miles and Huberman, 1994, p. 64). When the compliance between the opinions of expert and researcher reached 90% or above, the reliability is considered at a desired level (Saban, 2009). In this study, while there is a consensus in 103 of the 106 metaphors between the researchers and expert, dissonance occurred in three metaphors. The expert put "*toughness", "experience" and "gold"* metaphors into different categories from those of the researchers. The percentage ratio of the consensus was calculated and it was found as 97% (Reliability = 103/103+3 = 0.97).

RESULTS

Prospective teachers (PT) produced 106 different

Table 1. Science as synthesis of scientific knowledge.

Category	Metaphor code	Metaphor name	PCT* *f* (%)	PST* *f* (%)	Total *f* (%)
Science as Synthesis of Scientific Knowledge	21	Puzzle	-	1(33.3)	1 (20)
	51	Construction	-	1(33.3)	1 (20)
	56	Cake	1(50)	-	1 (20)
	100	Cooking	1(50)	1(33.3)	2 (40)
	Total (Metaphor)= 4(3.8)		Total (PTs)		5 (2.5)

**PCT: Prospective Classroom teachers; *PST: Prospective Science teachers*

metaphors related to science. The qualitative (metaphor expressions) and quantitative findings (tables) of these metaphors are presented in the following section.

Under which categories can these metaphors about the concept of science be classified?

Category 1: Science as synthesis of scientific knowledge

Table 1 shows the "*science as synthesis of scientific knowledge*" category along with the frequency and percentages of PTs for each metaphor. This category has a total of five PTs (2.5%) and four metaphors (3.8%). A metaphor of *cooking* was developed by the PTs from both programmes.

Metaphor extracts from the expressions used by the participants

Construction

Science is like construction, because evrything is sequent and ordered in the science. Lack of one of the layers of the information causes destruction such as construction (PST, 1).

Puzzle

Science is like puzzle, because if the parts and information are not combined, something meaningful does not occur (PST, 2).

Cooking

Science is like cooking, because cooking needs some materials. We have to obtain information by carrying out research, which is our material. Using these materials correctly, we try to cook something nice. If we do not use materials in the right place and the right amount, the food does not satisfy anyone. Science is like this situation and if we do not use the material, which is information, in the right place and do not establish correctly, correct or valid cases do not arise (PCT, 1).

Category 2: Science as a cumulative structure

Table 2 shows the metaphors under "*science as cumulative structure*" category along with the frequency and percentages of PTs for each metaphor. This category has a total of 14 PTs (6.9%) and 12 metaphors (11.3%). There are not any common metaphors stated by the participants from departments in this category. Each of the following metaphors: "*interlocking chain, to build a house, past days, tractor carrying sand, ladder, magnet, architecturel product, daffodil, technological innovations and food*" were mentioned by one PT. A *snowball* metaphor was given by two PCTs (28.6%); while a *pyramid* metaphor was stated by two PSTs (28.6%).

Metaphor extracts from the expressions used by the participants

Chain lap attached to each other

Science is like a chain lap attached to each other, because it has its parts following each other. New information can be gained or clarity can be provided to the reasons of the evnets happened in the past and present at the later stages with a knowledge we have acquired… (PST, 10).

To Build House

Science is like building a house, because you can add one more floor on top of your house if you have money. Science is like this too, with the increase of the information science shows advancement (PST, 9).

Snowball

Science is like a snowball; because that is how a small snowball grows with rolling on the snow, similar with snowball science is revealed by the hand of human and is grown by human. But science does not melt like a snowball; it continues growing within the time (PCT, 4).

Ladder

Science is like a ladder, because if the accumulation of

Table 2. Science as a cumulative structure.

Category	Metaphor code	Metaphor name	PCT *f* (%)	PST *f* (%)	Total *f* (%)
Science as a cumulative structure	17	Interlocking chain	-	1(14.3)	1(7.1)
	33	To Build House	-	1(14.3)	1(7.1)
	35	Past Days	-	1(14.3)	1(7.1)
	55	Snowball	2(28.6)	-	2(14.3)
	59	Tractor Carrying Sand	1(14.3)	-	1(7.1)
	68	Ladder	1(14.3)	-	1(7.1)
	69	Magnet	1(14.3)	-	1(7.1)
	70	Architectural Product	-	1(14.3)	1(7.1)
	71	Daffodil	1(14.3)	--	1(7.1)
	76	Pyramid	--	2(28.6)	2(14.3)
	91	Technological Innovations	-	1(14.3)	1(7.1)
	99	Food	1(14.3)	-	1(7.1)
	Total (Metaphor)=12(11.3)			Total (PTs)	14(6.9)

Table 3. Science as a dynamic structure.

Category	Metaphor code	Metaphor name	PCT *f* (%)	PST *f* (%)	Total *f* (%)
Science as a dynamic structure	6	Amoeba	-	1(5.9)	1(2.9)
	13	Bacteria	-	1(5.9)	1(2.9)
	23	Environment	-	1(5.9)	1(2.9)
	25	Change	2(11.8)	-	2(5.9)
	29	Nature	1(5.9)	1(5.9)	2(5.9)
	30	World	2(11.8)	2(11.8)	4(11.8)
	48	Revolution	1(5.9)	-	1(2.9)
	49	Human	7(41.2)	4(23.5)	11(32.4)
	50	Human Body	1(5.9)	-	1(2.9)
	82	Art	-	2(11.8)	2(5.9)
	88	A Waterfall Flowing Continuously	1(5.9)	-	1(2.9)
	90	Technology	1(5.9)	1(5.9)	2(5.9)
	101	New Born Baby	1(5.9)	1(5.9)	2(5.9)
	103	Innovation	-	1(5.9)	1(2.9)
	105	Time	-	2(11.8)	2(5.9)
	Total (Metaphor)=15(14.2)		Total (PTs)		34(16.7)

people's knowledge and discoveries are likened to the stairs of a ladder, people may climb it by adding something to their knowledge or they may be ribbed in any stairs (PCT, 6).

Category 3: Science as a dynamic structure

Table 3 shows the "*science as a dynamic structure*" category along with the frequencies and percentages of the PTs for each metaphor. This category includes a total of 34 PTs (16.7%) and 15 metaphors (14.2%). The metaphors; "*nature, world, technology and new born baby*" are represented in equal ratios by the participants from both programmes. While *human* metaphor were presented by seven PCTs (41.2%), this metaphor is presented by four PSTs (23.5%).

Metaphor extracts from the expressions used by the participants

Change

Science is like change, because science is not a stable, deadlock factor. In fact science is the epitome of change. A new always phenomenon enters under the heading of science, discredited information is removed; that is why science always changes (PCT, 14).

World

Science is like the world, because there is a continous change. Despite the presence and rules are known, there

Table 4. Science as basic requirement.

Category	Metaphor code	Metaphor name	PCT* f (%)	PST* f (%)	Total f (%)
Science as basic requirement	42	Air	2(15.4)	1(20)	3(16.7)
	53	Woman	-	1(20)	1(5.6)
	72	Oxygen	2(15.4)	1(20)	3(16.7)
	80	Soul	1(7.7)	-	1(5.6)
	86	Water	7(53.8)	2(40)	9(50)
	94	Toughness	1(7.7)	-	1(5.6)
	Total (Metaphor)= 6(5.7)			Total(PTs)	18(8.8)

are undiscovered aspects yet. We can not adapt to life if we do not follow the science, as if cannot be mentioned from humanity without world, also cannot be mentioned from the history of humanity without science (PST, 17).

Human

Science is like a human, because human undergoes many changes from infancy to grow. Science also progresses and developls slowly over time too (PST, 24).

Category 4: Science as basic requirement

Table 4 shows "*science as basic requirement"* category along with the frequencies and percentages of the PTs for each metaphor. This category is represented by 18 PTs (8.8%) and six metaphors (5.7%). However, the representation ratios of the "*air, oxygen and water*" metaphors are different across both programmes. While *air and oxygen* metaphors were represented by two PCTs (15.4%), *water* metaphors were represented by seven PCTs (53.8%). While, *air and oxygen* metaphors were represented by one PST (20%), *water* metaphors were given by two (40%) of PSTs.

Metaphor extracts from the expressions used by the participants

Air

Science is like air, because we need it in all areas of life. It is found in all places that we go. Like air is vital for human beings, vital problems cannot be solved without science (PCT, 17).

Oxygen

Science is like oxygen, because human beings need oxygen to live; they also need science to satisfy their curiosity, to learn, to apply technology to life… (PST, 32).

Water

Science is like water, because life cannot continue without water. The first civilizations have risen near the water. The water provides the contuinity of life. Science is like water too. In places where science exists, people advances. In places without water, there is no life; in parallel with this people cannot advance without science (PCT, 38).

Category 5: Science as a benefit provider

Table 5 shows the "*science as a benefit provider*" category along with the frequencies and percentages of the PTs for each metaphor. This category includes 54 PTs (26.5%) and 25 metaphors (23.6%). Both programmes gave "*moon, sun, light, and teacher*" metaphors. In the CTP, the *moon* metaphor was given by one PT (2.4%), the *sun* metaphor by 12 PTs (28.6%), the *light* metaphor by four PTs (9.5%), the *teacher* metaphor by three PTs (7.1%); whereas in the STP the *moon* metaphor was given by one PT (8.3%), the *sun* metaphor by one PT (8.3%), the *light* metaphor by three PTs (25%), and the *teacher* metaphor by one PT (8.3%).

Metaphor extracts from the expressions used by the participants

Clarity

Science is like clarity, because everything gains meaning with science. Science carries society to a higher status, more comfortable and bright future. Many questions in mind gain meaning and find answers through science (PCT, 52).

Sun

Science is like the sun, because how the sun makes human beings happy by providing benefit with its light and heat, science presents the objective knowledge obtained from the research to show the way to people. It is like the sun (PCT, 75).

Table 5. Science as a benefit provider.

Category	Metaphor code	Metaphor name	PCT* *f* (%)	PST* *f* (%)	Total *f* (%)
Science as a benefit provider	4	Gold	-	1(8.3)	1(1.9)
	8	Fireball	1(2.4)	-	1(1.9)
	9	Moon	1(2.4)	1(8.3)	2(3.7)
	10	Clarity	3(7.1)	-	3(5.6)
	14	Simple machine	-	1(8.3)	1(1.9)
	16	Riddle	1(2.4)	-	1(1.9)
	20	Chameleon	1(2.4)	-	1(1.9)
	22	Geographical discoveries	1(2.4)	-	1(1.9)
	31	Dominancy	1(2.4)	-	1(1.9)
	32	The most important piece of us	-	1(8.3)	1(1.9)
	36	Future	1(2.4)	-	1(1.9)
	41	Sun	12(28.6)	1(8.3)	13(24.1)
	46	Light	4(9.5)	3(25)	7(13)
	47	Medicine	3(7.1)	-	3(5.6)
	52	Functioning Iron	-	1(8.3)	1(1.9)
	57	Guide	1(2.4)	-	1(1.9)
	60	Rescuer	1(2.4)	-	1(1.9)
	62	Fur	1(2.4)	-	1(1.9)
	64	Lamp	2(4.8)	-	2(3.7)
	74	Teacher	3(7.1)	1(8.3)	4(7.4)
	77	Compass	2(4.8)	-	2(3.7)
	78	Guideline	1(2.4)	-	1(1.9)
	89	Experience	-	1(8.3)	1(1.9)
	97	Rain	2(4.8)	-	2(3.7)
	106	Time machine	-	1(8.3)	1(1.9)
	Total(Metaphor)				25(23.6)
	Total (PTs)				54(26.5)

Table 6. Science as an occupation requiring curiosity, labor, excitement and time.

Category	Metaphor code	Metaphor name	PCT *f* (%)	PST *f* (%)	Total *f* (%)
Science as an occupation requiring curiosity, labor, excitement and time	1	Tree	8(47.1)	4(44.4)	12(46.2)
	12	Garden	-	1(11.1)	1(3.8)
	15	Computer	1(5.9)	-	1(3.8)
	18	Individual	-	1(11.1)	1(3.8)
	24	Strawberry	-	1(11.1)	1(3.8)
	44	Treasure	1(5.9)	-	1(3.8)
	61	Little Child	2(11.8)	-	2(7.7)
	75	Pastry	-	1(11.1)	1(3.8)
	79	Novel	1(5.9)	-	1(3.8)
	81	Clock	2(11.8)	-	2(7.7)
	93	Seed	1(5.9)	-	1(3.8)
	102	Child Learning New Things	1(5.9)	1(11.1)	2(7.7)
	Total(Metaphor)	12(11.3)		Total (PTs)	26(12.8)

Teacher

Science is like a teacher, because science is a collection of useful information. We also obtain useful information from teachers (PST, 45).

Category 6: Science as an occupation requiring curiosity, labor, excitement and time

Table 6 shows "*science as an occupation, requiring curiosity, labour, excitement and time*" category. This

Table 7. Science as an infinite structure.

Category	Metaphor code	Metaphor name	PCT *f* (%)	PST *f* (%)	Total *f* (%)
Science as an infinite structure	2	Flowing water	1(12.5)	-	1(4.5)
	26	Sea	-	1(7.1)	1(4.5)
	34	Universe	1(12.5)	1(7.1)	2(9.1)
	39	Sky	1(12.5)	2(14.3)	3(13.6)
	54	Cosmos	1(12.5)	-	1(4.5)
	73	Ocean	1(12.5)	2(14.3)	3(13.6)
	84	Infinite ladder	1(12.5)	1(7.1)	2(9.1)
	85	Infinity	1(12.5)	1(7.1)	2(9.1)
	87	Process	-	1(7.1)	1(4.5)
	95	Skyline	-	1(7.1)	1(4.5)
	96	Space	-	4(28.6)	4(18.2)
	104	Way	1(12.5)	-	1(4.5)
	Total (Metaphor)= 12(11.3)			Total(PTs)	22(10.8)

category includes 26 PTs (12.8%) and 12 metaphors (11.3%). The "*tree and child learning new things*" metaphors are represented by PTs from both programmes. In the CTP *tree* metaphors were given by eight PTs (47.1%) and *child learning new things* metaphor by one PT (5.9%); whereas in the STP the *tree* metaphor was given by four PTs (44.4%), and the *child learning new things* metaphor by one PT (11.1%).

Metaphor extracts from the expressions used by the participants

Tree

Science is like a tree, because at first when it is a sapling, it needs interest. It grows, becomes more vibrant and stronger with the interest (surveys, experiments) shown to it. Like water is very important for sapling, the curiosity and interest are very important for science too (PST, 47).

Little child

Science is like a little child, because a little child is grown by people taking care with great interest and effort. Science is like this situation; it develops with the labor (PCT, 97).

Clock

Science is like a clock, because it continuously works when it is maintained. If we appreciate and contribute to science, it continuously works and develops (PCT, 92).

Category 7: Science as an infinite structure

Table 7 shows "*science as an infinite structure*" category along with the number and percentages of the PTs for each metaphor. This category has a total of 22 PTs (10.8%) and 12 metaphors (11.3%). Metaphors of *the universe, the sky, the ocean, infinite ladder, and infinity* were given by the participants from both programmes. In the CTP *the universe* metaphor was given by one PT (12.5%), the *ocean* metaphor by one PT (12.5%), the *infinite ladder* metaphor by one PT (12.5%) and the *infinity* metaphor by one PT (12.5%); whereas in the STP the *universe* metaphor represented by one PT (7.1%), the *ocean* metaphor by two PTs (14.3%), the *infinite ladder* metaphor by one PT (7.1%) and the *infinity* metaphor by one PT (7.1%). While *space* metaphor was given by four prospective teachers (28.6%), the other metaphors "*skyline, process*" represented by 1 PT.

Metaphor extracts from the expressions used by the participants

Sky

Science is like the sky, because it covers the whole of humanity. Everyone sees an eternity of endless when you look up the sky. Science is very wide like the sky (PCT, 101).

Ocean

Science is like the ocean, because the ocean is an endless water mass that evokes eternity. Like the ocean science is endless information mass. In science the desire of knowing and researching never ends. Subject area is so large that all sorts of things can be the subject of science (PCT, 106).

Space

Science is like the space, because it has a deep and

Table 8. Science as a tool for understanding events and phenomena.

Category	Metaphor code	Metaphor name	PCT *f* (%)	PST *f* (%)	Total *f* (%)
Science as tool for understanding events and phenomena	7	Key	1(12.5)	-	1(4.5)
	11	Mirror	1(12.5)	1(7.1)	2(9.1)
	19	Effort to understand something	-	1(7.1)	1(4.5)
	28	Language	1(12.5)	-	1(4.5)
	37	Development	1(12.5)	-	1(4.5)
	38	Google	1(12.5)	-	1(4.5)
	43	Life	1(12.5)	6(42.9)	7(31.8)
	45	Everything	-	1(7.1)	1(4.5)
	58	Book reading	1(12.5)	1(7.1)	2(9.1)
	67	Picklock	1(12.5)	-	1(4.5)
	98	Living	-	4(28.6)	4(18.2)
	Total (Metaphor)=	11(10.4)	Total (PTs)		22(10.8)

unknown vacuum. Although there are all kinds of discovered planets within the space, there are undiscovered planets and structures. Science is like this; all inventions bring other inventions (PST, 57).

Category 8: Science as a tool for understanding events and phenomena

Table 8 shows "*science as a tool for understanding events and phenomena*" category along with the number and percentages of the students for each metaphor. This category has a total of 22 students (10.8%) and 11 metaphors (10.4%). Metaphors of *mirror, life and book reading* were given by the students from both programmes. In the CTP, the *mirror* metaphor was given by one student (12.5%) the *life* metaphor by one student (12.5%), and the *book reading* metaphor by one student (12.5%); whereas in the *STP mirror* metaphor was given by one student (7.1%), the *life* metaphor by six students (42.9%) and the *book reading* metaphor by one student (7.1%). While the *living* metaphor was given by four students (28.6%), the others "*everything* metaphor and *effort to understand something* metaphor" represented by 1 student.

Metaphor extracts from the expressions used by the participants

Language

Science is like a language, because while language provides agreement and common ground among humans, science provides an agreement between human and nature (PCT, 111).

Although the reasons for the life and living metaphors close to each other, these have been proposed as two separate metaphor images by the teacher candidates.

Life

Science is like life, because all the requirements of life are found with scientific studies. Since the first human, human being consciously or unconsciously has made science (PST, 77).

Life

Science is like life, because it happens in every moment. We are just trying to discover it (PST, 70).

Category 9: Rationalist (positivist) perspective

Table 9 shows "*rationalist (positivist) perspective"* category along with the number and percentages of the students for each metaphor. This category has a total of nine students (4.4%) and nine metaphors (8.5%).

Metaphor extracts from the expressions used by the participants

Observation

Science is like observation, because observation is necessary for us to reach scientific data (PST, 86).

Laboratory

Science is like a laboratory, because scientific information is verified, raked up through experiments. Until the information turns into science it goes through

Table 9. Rationalist (positivist) perspective.

Category	Metaphor Code	Metaphor Name	PCT *f* (%)	PST *f* (%)	Total *f* (%)
Rationalist Perspective (Positivist)	3	Mind	-	1(16.7)	1(11.1)
	5	Deeds registry	1(33.3)	-	1(11.1)
	27	Lesson planning	-	1(16.7)	1(11.1)
	40	Observation	-	1(16.7)	1(11.1)
	63	Laboratory	1(33.3)	-	1(11.1)
	65	Lego Game	1(33.3)	-	1(11.1)
	66	Mathematics	-	1(16.7)	1(11.1)
	83	Systematical whole	-	1(16.7)	1(11.1)
	92	Whole composed of theories	-	1(16.7)	1(11.1)
	Total (Metaphor)= 9(8.5)			Total (PTs)ent)	9(4.4)

Table 10. Differences in conceptual categories according to the type of attended programme.

Category	PCT *f* (%)	PST *f* (%)	Total *f* (%)
1- Science as synthesis of scientific knowledge	2(1.7)	3(3.4)	5(2.5)
2- Science as a cumulative structure	7(6)	7(8)	14(6.9)
3- Science as a dynamic structure	17(14.5)	17(19.5)	34(16.7)
4- Science as basic requirement	13(11.1)	5(5.7)	18(8.8)
5- Science as a benefit provider	42(35.9)	12(13.8)	54(26.5)
6- Science as an occupation requiring curiosity, labour, excitement and time	17(14.5)	9(10.3)	26(12.7)
7-Science as an infinite structure	8(6.8)	14(16.1)	22(10.8)
8- Science as a tool for understanding events and phenomena	8(6.8)	14(16.1)	22(10.8)
9-Rationalist (positivist) perspective	3(2.6)	6(6.9)	9(4.4)
Total (student)			204(100)

Pearson chi-square $\chi 2$ = 23.24 sd=8.

several stages, a lot of processes are made in the laboratory (PCT, 117).

Lego Game:

Science is like lego game, because something emerges as a result of the combination of tiny meaningless fragments, science revealed as a result of the combination of observed events (PCT, 116).

Systematical whole

Science is like a systematical whole, because it investigates, wonders, queries. It is composed of the steps such as hypothesis, observation and data collection (PST, 82).

Do conceptual categories vary according to attended programme type?

Table 10 shows conceptual categories as they vary according to attended program type. A possible interpretation of these results are as follows: There is a significant relationship between the categories that include the metaphors developed by PTs and their departments ($p < .05$), and the distribution of the metaphors according to the categories shows significant difference as follows: (ı) "*science as a cumulative structure*" and "*science as a dynamic structure*" categories produced an equal proportion of metaphors from both programmes. (ıı) the number of PTs in the "*science as a synthesis of scientific knowledge*" category is close to each other in both programmes and this category is represented by relatively few students when compared to other categories; (ııı) in the category of "*science as basic requirement*", the PCTs produce more metaphors than PSTs (ıv) in the category of "science as a benefit provider", representing numbers of PTs to the metaphors developed by PCTs are relatively higher compared to other categories and programme type; (v) in the category of "*science as an occupation requiring curiosity, labor, excitement and time*", the number of PCTs is almost twice the number of PSTs; (vı) in the categories of "*science as an infinite structure*", "*science as a tool for understanding events and phenomena*" and "*rationalist (positivist) perspective*", the number of metaphors produced by PSTs is almost twice the number of PCTs.

DISCUSSION

Although there are studies which advocate that students understand the nature of the science easily by scientific research and investigation performance (Lederman and Niess, 1997), it is assumed that teachers reflect their perception, knowledge and beliefs to their teaching programme and practices (Turgut, 2009). As prospective teachers, their perceptions, perspectives and attitudes are important to this embedded assumption.

When we examine the categories, codes and metaphorical expressions of this study in detail, we can say that the PTs' perceptions related to science are not internalised, but occur at a superficial level close to a post-positivist perspective, and at a level including some myths close to positivism. These findings are parallel to the myths related to nature of science determined by McComas (1998) and also these findings reiterated the findings of other related studies conducted with PTs by Gürses et al. (2005) and Turgut (2009).

Since the category and codes of the current study were determined basing on PTs' metaphorical expressions, the categories and sub-codes of this study could be considered as important in elaborating their perceptions.

The percentage of PSTs that fall into the categories of "science as the synthesis of scientific knowledge, science as a cumulative structure" is higher than PCTs' percentage. In these two categories, it attracts attention that PTs have accurate, reliable, precise scientific knowledge opinion. This situation is considered as the reflection of realistic (positivist) opinion to be found more commonly amongst PSTs. The reflections of this opinion are seen in the following metaphor extract:

Science is like construction, because everything is sequent and ordered in the science. Lack of one of the layers of the information causes destruction such as construction (PST, 1)

This response is parallel to the findings of the study carried out by Turgut with PSTs (2009). According to Turgut, PSTs showed signs that scientific knowledge was perceived to be isolated from the other knowledge types and sometimes they considered scientific knowledge as superior. According to this finding we can say positivist perspectives are more dominant than post- positivist perspectives about science concept in the STP.

It is noteworthy that the opinion of *scientific knowledge is changeable* and the perception of hierarchical (stepwise) method in the following extract:

"*Science is like architectural product, because a product is formed through passing stages. We need to lay a solid foundation, it must be durable. Science brings out something towards certain purposes such as architectural product. It may be rebutted like destruction of an architectural product if we do not lay a solid foundation of it"* (PST, 4).

There are expressions from which scientifically valid and meaningful results can be obtained if the correct establishment is done within the scope of the metaphor expression through these two categories. This opinion is dominant in above "cooking" metaphor too. The result-oriented science perception summarized as "True, solid knowledge substantion = valid, meaningful scientific results" in PTs is a reflection of positivism in terms of verifiability of sublimation.

While 19.5% of the metaphors found in the category of "*science as a dynamic structure*" were developed by PTs attending to STP, 14.5% of these metaphors were developed by PTs attending the CTP. This category is second in terms of the variety of metaphors developed and representative number of PTs. The findings in this category show that PSTs and PCTs are aware of dynamism or variability characteristics of the scientific knowledge in the NOS. This finding can be considered as the improvement of perspectives about scientific knowledge of PSTs and PCTs in modern sense. It is desired one to close the gap in science education because they will teach science in the future. This finding is consistent with the results of the study on the NOS conducted by Türkmen and Yalçın (2001). According to these authors, science is dynamic and ongoing activity. There is no absolute truth in science, where variability and temporality are instead it is the main characteristics of science. And also according to Popper (cited in Doğan, Çakıroğlu, Bilican and Çavuş, 2012), scientific knowledge may vary depending on new observations and re-interpretation of existing observations. Scientific knowledge is reliable and long lasting, but it s not fully accurate and absolute. The facts, theories and laws within the scope of scientific knowledge may vary through the consideration of new evidences, new technological developments.

The next metaphorical expression is close to this statement in sense.

"Science is like a change, because science is not a stable, deadlock factor. In fact science is the epitome of change. Always new phenomena enter under the heading of science, discredited knowledge removed; that is why science always changes" (PCT, 14).

The percentage of PTs attending to CTP is nearly two times more than the percentage of those from PTs attending to the STP in the category of "*science as a basic requirement*". The reasons in the metaphor images can be considered as a reflection of the consideration of science is important for PCTs and they have positive attitudes towards the concept of science. This statement does not mean PSTs completely have a negative attitude. Since practicing classroom teachers are the most effective people at the basic level in science education and they shape students' perceptions and attitudes about the science, the higher percentage of

PCTs is promising and positive in this respect.

"*Science as a benefit provider*" category had the highest percentage of metaphors. Depending on this finding we can infer that PTs focused on the outcomes of science, in other words, product or result-oriented approach is dominant amongst both PCTs and PSTs. This can be clearly seen in the following extract:

Science is like dominancy, because science in developed countries carries the technology of the country to 'the top' and it makes a market there by selling manufactured goods to underdeveloped countries. Thus in a sense, developed country apply economic pressure to underdeveloped country (PCT, 73).

In the historical process there are two approaches in investigation and understanding the science (Terzi, 2005). While the first approach is "*science as a product*" the other approach is "*science as an activity*". Science as a product tries to make science when considering the products of science (Uyanık, 2003, p.93).

"*Science as an occupation requiring curiosity, labour, excitement and time*" is the third of nine categories according to the percentage ranks. Interest, curiosity, excitement and desire are words found in the following expression that are consistent with the role of the scientist in the scope of modern science perspective (Doğan et al., 2012).

Science is like children learning new things, because children learning new things would be curious and excited. These children want to learn more. They spend effort for this. They are always enthusiastic. With the new discoveries the wonder increases and they want to find out more things (PST, 53).

According to the metaphors included in the category of "*science as an infinite structure*", PTs believe that everything in the universe may be the subject of science.

Science is like an ocean, because the ocean is endless water mass that evokes eternity. Like the ocean, science is endless mass of knowledge. In science, the desire of knowing and researching never ends. Subject areas are so large that all sorts of things can become the subject of science (PCT, 106).

The above expression of metaphor and the other metaphorical expressions found in this category show that PTs are not fully aware of the fact that "the world can be understood through science, but science can not fully answer all questions" proposal which is suggested for scientific literacy (AAAS, 1990).

The aim of the science is to understand the functioning of phenomena, relationships among phenomena, and briefly understand the universe, taken as the whole of phenomena (Yıldırım, 2005, p. 17). This is emphasized in the following extract:

Science is like a language, because while language provides common ground and agreement among humans, science provides an agreement between human and nature (PCT, 111).

In the category of "*science as a tool for understanding events and phenomena*", the percentile level of PTs from the STP is higher than it is for those from the CTP. This situation may also correlate with the lessons and their contents that are taught in the STP.

The following determinations are important to provide explanations for RQ3.

The percentage level of PST is about three times higher than PCTs in the category of "*rationalist (positivist) perspective*". The following expressions of metaphor show that PSTs understanding of science is close to a positivist perspective, which is called traditional scientific understanding.

Science is like a lesson plan, because when we look at a lesson plan we can see objectivity in it. There is objectivity in science; it does not change person to person (PST, 83).

According to Palmaquist and Finley (1997), the perception of objectivity overlaps with traditional scientific understanding. Misconceptions about the nature of science are called myths. McComas (1998) considers this perception as one of the myths about the nature of science.

Science is like observation, because observation is necessary for us to reach scientific data (PST, 86).

The perception about the process of observation bears the traces of a positivist perspective. According to Gürses et al. (2005), scientific theories cannot be produced solely basing on observation, but are invented by people to make sense of observations.

According to Lederman et al. (2002), one of the most common misconceptions about science is the myth of the scientific method and of the sequencing of the activities during scientific studies; in fact there is no hierarchy applied in the form of rules. The scientific method can be seen here:

Science is like a whole composed of theorises, because science is wholely composed of the theories given by the scientists. It is constituted by the results of the experiments. There is no science without experiment. It must contain a report (PST, 84).

These findings overlap with the findings of Turgut's (2009) study. He points out the majority of PSTs claimed that the hypotheses turn into laws through the inspection and subsequent validation processes, and they tried to reveal a scientific method design in this way.

In Turkey, the scientific method is taught to students as the sole method for problem-solving in secondary school biology textbooks (Doğan et al., 2012). The presence of this perception is carried over from secondary school (Turgut, 2009) to higher education, which can be interpreted as these PTs not having received a meaningful and persistent science education.

CONCLUSION AND RECOMMENDATION

The present study shows that metaphors might be used as a powerful tool in revealing PSTs and PCTs' perceptions about the concept of science. By using these metaphors teacher trainers can motivate PTs on learning science and make their lessons more effective so that they can find common grounds with PTs and may create a warm atmosphere. In addition, it is thought that qualitative and quantitative studies, which consider the teacher trainers, PTs' or practicing teachers' science perceptions will contribute to this area and also thought that this will offer information and perspective to teacher trainers. We should highlight that this study might also have implications for researchers and teacher trainers worldwide, especially in Europe. Turkey has been part of the Erasmus Programme since 2004 (Ersoy, 2013). As a result, Turkish PTs travel broadly in Europe for their studies. In a multicultural class atmosphere, the majority of which is European, if a teacher trainer knows the others' (Turkish, Arabic or Chinese) attitudes and perspectives related to science, an efficient, meaningful communication and education can take place. It is thought that using metaphorical expressions presented in this study related to courses will be useful for PSTs and PCTs in recognising different perspectives on science, in questioning their own perspectives, as well as in bringing their perceptions of science up to date. The researchers can utilise metaphorical expressions revealed in this study for the purpose of developing scales related to the science perspectives of PTs. In addition, an efficient science education should be provided to PSTs and PCTs to show recognition of different scientific paradigms towards the overall development and strengthening of the perceptions of modern scientific understanding. Because when they begin their teaching profession the PCTs will teach science at entry level in 1,2,3 and 4 in elementary schools; the PSTs will teach science in grades 5, 6, 7, 8 in secondary schools. Of course, teacher education is a complex multifarious issue (Schoeman and Mobunda, 2012), but we can assume that the development of PSTs and PCTs' perceptions, attitudes and perspectives related to science will contribute to closing the gap in science education.

Notes

A short version of this study was presented in ULEAD Annual Congress (Multi- paradigmatic Transformative Research in Education: Challenges and Opportunities) in May 31- June 2**,** 2013 in Nevsehir, Turkey, as an oral presentation.

Conflict of Interests

The author(s) have not declared any conflict of interests.

REFERENCES

Abd-El-Khalick F, Bell RL, Lederman NG (1998) The nature of science and instructional practice: making the unnatural natural. Sci. Educ. 82:417-437.

Abd-El-Khalick F, Lederman NG (2000). Improving science teachers' conceptions of the nature of science: A critical review of the literature. Int. J. Sci. Educ. 22:665-701.

American Association for the Advancement of Science (AAAS). (1990). *Science for all Americans*. New York: Oxford University Press.

Arslan MM, Bayrakçı M (2006). Metaforik düşünme ve öğrenme yaklaşımının eğitim-öğretim açısından incelenmesi. *Milli Eğitim*, 35(171):100-108.

Aslan O, Yalçın N, Taşar MF (2009). The Views of the Teachers of the Science and Technology on the Nature of Science. *Ahi Evran Üniversitesi Eğitim Fakültesi Dergisi*. 10(3):1-8.

Ateş M, Karatepe A (2013). The Analysis Of University Students' Perceptions Towards "Environment" Concept With The Help Of Metaphors. *Int. J. Social Sci.* 6 (2):1327-1348.

Bahadır E, Özdemir AŞ (2012). İlköğretim 7. Sınıf Öğrencilerinin Matematik Kavramına İlişkin Sahip Oldukları Zihinsel İmgeler. *Int. J. Social Sci. Res.* 1(1):26-40.

Botha E (2009). Why metaphor matters in education. *South Afr. J. Educ.* 29:431-444.

Buaraphan K (2011). Metaphorical Roots of Beliefs about Teaching and Learning Science and their Modifications in the Standard-Based Science Teacher Preparation Programme. *Int. J. Sci. Educ.* 33:11.

Cerit Y (2006). Öğrenci, öğretmen ve yöneticilerin okul kavramıyla ilgili metaforlara ilişkin görüşleri. *Kuram ve Uygulamada Eğitim Bilimleri Educational Sciences: Theory Practice.* 6(3):669-699.

Çepni S, Ayvacı HŞ, Bacanak A (2006). Fen Teknoloji Toplum (3. Baskı). Trabzon. Celepler Matbaacılık.

Doğan N, Çakıroğlu J, Bilican K, Çavuş S (2012). *Bilimin Doğası ve Öğretimi*. Ankara: Pegem Akademi.

Döş İ (2010). Aday Öğretmenlerin Müfettiş Kavramına İlişkin Metafor Algıları. *Gaziantep Üniversitesi Sosyal Bilimler Dergisi*. 9(3):607-629.

Driver R, Leach J, Millar R, Scott P (1996). *Young People's Images of Science*. Buckingham: Open University Press.

Ersoy A (2013). Turkish Teacher Candidates' Challenges Regarding Cross-cultural Experiences: The Case of Erasmus Exchange Program. *Educ. Sci.* 38(168):154-166.

Forceville C (2002). The identification of target and source in pictorial metaphors. *J. Pragmatics*. 34:1-14.

Gürses A, Doğar Ç, Yalçın M (2005). Bilimin doğası ve yüksek öğrenim öğrencilerinin bilimin doğasına dair düşünceleri. *Milli Eğitim Dergisi*. 33:166.

Hurd PD (1998). Scientific Literacy: New Minds for a Changing World. Retrieved [on March 29, 2012] from: http://nuwrite.northwestern.edu/communities/science-writing-community/docs/science-writing-assignments-grading/general-science-writing-skills/pedagogical-articles-research-studies/on-science-literacy/Hurd_scientific%20literacy.pdf

Jeppsson F, Haglund J, Amin TG, Strömdahl H (2013). Exploring the Use of Conceptual Metaphors in Solving Problems on Entropy, *J. Learn. Sci.* 22(1):70-120.

Lakoff G, Johnson M (2005). *Metaforlar: Hayat, anlam ve dil* (Çeviren G.Y. Demir). İstanbul: Paradigma.

Lederman NG (1992). Students' and teachers' conceptions about the nature of science: A review of the research. J. Res. Sci. Teach. 29:331–359.

Lederman NG, Abd-El-Khalick F, Bell R, Schwartz R (2002). Views of nature of science questionnaire: Toward valid and meaningful assessment of learners' conceptions of nature of science. *J. Res. Sci. Teach.* 39(6):497-521.

Lederman NG, Niess ML (1997). The Nature Of Science: Editorial. *School Sci. Math.* 97:1-2.

McComas WF (1998). *The Principal Elements of the Nature of Science: Dispelling the Myths.* The Nature of Science in Science Education. Netherlands. Kluwer Academic Publishers.

MEB (2004). Milli Eğitim Bakanlığı. İlköğretim Fen ve Teknoloji Dersi (4.

ve 5. Sınıflar) Öğretim Programı. Ankara: Devlet Kitapları Müdürlüğü Basım Evi.
Miles MB, Huberman AM (1994). *Qualitative data analysis*. Thousand Oaks, CA: Sage.
Morgan G (1980). Paradigms, Metaphors, And Puzzle Solving in Organizational Analysis. *Admin. Sci. Q.* 25:606-622.
Morgan G (1998). Yönetim ve Örgüt Teorilerinde Metafor (Çev. Gündüz Bulut). İstanbul: BZD Yayıncılık.
Niebert K, Marsch S, Treagust DF (2012). Understanding Needs Embodiment: A Theory-Guided Reanalysis of the Role of Metaphors and Analogies in Understanding Science. *Science Education*, DOI 10.1002/sce.21026.
Oflaz G (2011). İlköğretim Öğrencilerinin 'Matematik' ve 'Matematik Öğretmeni' kavramlarına İlişkin Metaforik Algıları. 2nd *International Conference on New Trends in Education and Their Implications* 27-29 April, Antalya-Turkey.
Oxford RL, Tomlinson S, Barcelos A, Harrington C, Lavine RZ, Saleh A, Longhini A (1998). Clashing metaphors about classroom teachers: Toward a systematic typology for the language teaching field. *System*. 26:3-50.
Perry S (2011). Metaphor Theory: Language's Window To The Mind. Master Thesis. San Diego State University.
Saban A [Ahmet] (2004). Giriş düzeyindeki sınıf öğretmeni adaylarının "öğretmen" kavramına ilişkin ileri sürdükleri metaforlar. *Türk Eğitim Bilimleri Dergisi*, 2(2):131-155.
Saban A [Ahmet] (2008). Okula ilişkin metaforlar. *Kuram ve Uygulamada Eğitim Yönetimi*, 55:459-496.
Saban A [Ahmet] (2009). Öğretmen adaylarının öğrenci kavramına ilişkin sahip oldukları zihinsel imgeler. *Türk Eğitim Bilimleri Dergisi*. 7(2):281-326.
Saban A [Aslıhan]. (2011). Prospective Computer Teachers' Mental Images about the Concepts of "School" and "Computer Teacher" *Kuram ve Uygulamada Eğitim Bilimleri, Educational Sciences: Theory Practice.* 11(1):435-446.
Schoeman S, Mabunda PL (2012). Teaching practice and the personal and socio-professional development of prospective teachers. *South Afr. J. Educ.* 32:240-254.
Seferoğlu G, Korkmazgil S, Ölçü Z (2009). Gaining insights into teachers' ways of thinking via metaphors. *Educ. Stud*. 35 (3):323-335.
Strenski E (1989). Disciplines and Communities, Armies and Monasteries and The Teaching of Composition. *Rhetoric Rev*. 8 (1).
Sünbül AM (2010). *Öğretim İlke Ve Yöntemleri*. Konya: Eğitim Kitabevi.
Terzi AR (2005). Üniversite öğrencilerinin bilimsel epistemolojik inançları üzerine bir araştırma. *Afyon Kocatepe Üniversitesi Sosyal Bilimler Dergisi*. 298–311.
Thomas GP, McRobbie CJ (1999). Using metaphor to probe students' conceptions of chemistry learning. Int. J. Sci. Educ. 21(6):667-685.
Tsai CC (1998). An Analysis of Scientific Epistemological Beliefs and Learning Orientations of Taiwanese Eight Graders. *Sci. Educ.* 82:473-489.
Turgut H (2009). Fen Bilgisi Öğretmen Adaylarının Bilimsel Bilgi Ve Yöntem Algıları. *Türk Eğitim Bilimleri Dergisi*. 7(1):165-184.
Türkmen H, Yalçın M (2001). Bilimin Doğası ve Eğitimdeki Önemi. *Afyon Kocatepe Üniversitesi Sosyal Bilimler Dergisi*. 3(1):189-195.
Uskokovic V (2009). On Science of Metaphors and the Nature of Systemic Reasoning. *World Futures: J. Global Educ.* 65(4):241-269.
Uyanık M (2003). *Felsefi Düşünceye Çağrı*. İstanbul: Elis Yayınları.
Yıldırım A, Şimşek H (2005). *Sosyal Bilimlerde Nitel Araştırma Yöntemleri*. Ankara: Seçkin Yayınevi.
Yıldırım C (2005). *Bilimin Öncülleri*. Ankara: Yenigün Matbaası.
Yob IM (2003). Thinking constructively with metaphors. *Stud. Philosophy Educ.* 22:127-138.