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Identifying Pre-Service Science and Technology Teachers' Perceptions Related to the Concept of Physics through Metaphors

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ABSTRACT
In this study, the aim was to identify pre-service Science and Technology teachers' perceptions related to the concept of Physics through metaphors. Within the scope of this aim, an answer was sought to the question; 'What are pre-service science and technology teachers' perceptions about the concept of physics?'. In this way, 82 1st grade pre-service Science and Technology teachers from a Faculty of Education at a university in Turkey who formed the sample of this study were asked to complete the sentence; 'Physics is like...; because...'. Documents containing pre-service Science and Technology teachers' answers to the open-ended questions were used as data sources. Data have been analyzed by content analysis method, all the metaphors and justifications expressed by participant teacher candidates have been examined, their common properties have been identified and themes considered that they can represent these have been developed. Obtained results show that teacher candidates perceive the concept of physics mostly as "the life itself/the reflection of life", "the source of scientific explanations", developing-changing/an endless science" and "efforts of discovering/ understanding life".
Key words: *pre-service science and technology teachers, physics, metaphor.*

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INTRODUCTİON

Physics lesson is generally seen as an abstract, theoretical lesson which is difficult to understand, a pile of formulas not directly related to the society and people, or boring and full of unnecessary information (Ahlgren and Walberg, 1973; Whitelegg and Parry, 1999; Tekbiyik and Akdeniz, 2010). It may be considered that students' view of Physics lesson as a difficult, boring and unimportant lesson may affect their interest in Physics thus their success in a negative way. It is likely that one of the reasons of the occurrence of this view originates from in-class applications of the teachers that teach physics lesson. At this point, it can be considered that science and technology teacher candidates' perceptions of physics, who will teach physics at primary education level in the future, may have positive or negative effects on their own teaching activities and students' perceptions of physics. For that reason, it is important to take into consideration that pre-service teachers' perceptions related to the concept of physics, should influence their teaching life in future. That is why it is thought that identifying the ideas pre-service science and technology teachers have about the concept of Physics may provide benefits in terms of determining their approaches to teaching Physics.

In addition to this, it is considered that identified perceptions will present important knowledge about the applications for the experts in the field of teacher training. It is observed that, in educational research, there are various studies in which metaphors are used to identify perceptions related to the concepts of student, teacher/instructor, educational technologies and school, which are components of the education process. Metaphors, one of the basic cognitive models that shape the thoughts of people regarding the truth and the world, enable the understanding development regarding unknown phenomenon by comparing the abstract and complicated phenomenon with more concrete and experienced phenomenon (Ocak and Gunduz, 2006). Similarly, it is expressed that people have to make comparisons with other concepts in order for people to understand a phenomenon (İbret and Aydınozu, 2011). In that respect, it is indicated that metaphors provide contributions from the point of detecting how the concepts asked to be analyzed are perceived (Cerit, 2008; Aydın and Eser-Unaldı, 2010).

In this study, the aim was to identify pre-service Science and Technology teachers' perceptions related to the concept of Physics through metaphors. Within the scope of this aim, an answer was sought to the question; 'What are pre-service science and technology teachers' perceptions about the concept of physics?'.

METHODOLOGY OF RESEARCH

In this research, within the scope of a qualitative study, phenomenographic research design has been employed. Phenomenographic research analyzes the way how individuals express their cognitive structures related to various concepts, events, or processes. Phenomenographic research does not judge people's ideas regarding the accuracy of them or how they are compatible with the facts. Phenomenography is a research method which helps researchers conceptualize various ideas, objects, phenomenon and experiences in the life, so that researchers can create some patterns about them (Marton, 1986). The reason for selecting this methodology is that it provides a chance to see how teacher candidates view and perceive the physics concept and to conduct a detailed analysis on their views and perceptions.

Sample of Research

A total of 82 first–grade teacher candidates of Science and Technology in Education Faculty, 52 of whom are female and 30 of whom are male, makes up the sample of the study in which descriptive method has been used.

Data Collection Instrument

In accordance with the aim of the research, teacher candidates have been asked to complete the blank form including the sentence "Physics is like.....; because.....". Accordingly, in the study, documents including answers given by the teacher candidates of science for open – ended questions have been used as data source.

Data Analysis

Data have been analyzed by content–analysis method. Accordingly, by identifying the common properties of participant teacher candidates in the result of analyzing all the metaphors and justifications expressed by the participant teacher candidates, categories/themes considered to represent these have been developed. In that process, the metaphor each participant presents have been coded (for example, "formula", "sleepless night", etc.). A metaphor list from coded metaphors has been prepared as an application source in gathering metaphors in a specific category. In the next stage, metaphors produced by participants regarding the concept of physics have been studied basically in terms of common properties. In this process, the metaphor list previously formed has been utilized and the correlation between each produced metaphor and the metaphor's topic (physics) has been analyzed considering the explanations made. At the end of this analysis, a total of 8 different conceptual categories have been made up by correlating each metaphor with a specific theme in terms of the perspective that it has regarding the concept of physics (for example, "physics as a stressful-abstruse subject", etc.) In order to enable the reliability of the study, expert opinion has been applied with the aim of confirming whether metaphor images given under 8 conceptual categories reached through the study symbolize an in-question conceptual category or not. The expert has been asked to match the metaphors in the metaphor list with categories in the list consisting of 8 different conceptual categories by giving lists consisting of the metaphor list and 8 different conceptual categories (not including metaphors) (Saban, 2008). At the end of this comparison, determining the numbers of consensus and dissensus, the reliability of the study has been assessed by using the formula of Miles and Humberman (1994) as "Reliability= number of agreements / (total number of agreements + disagreements)" and it has emerged that a consensus at the rate of 91% (reliability) has been provided.

Results of Research

Obtained findings from the answers of the science and technology teacher candidates for the open-ended questions have been presented in this part. Metaphors towards the concept of "physics" produced by teacher candidates have been given in Table 1.

Table 1. Metaphors Produced For the Concept of Physics

The name of the metaphor	f	The name of the metaphor	f	The name of the metaphor	f
Activity	1	Eating	1	Nature	1
Adrenaline	1	Effect	2	Oxygen	1
Angel	1	Energy	1	Plain paper	1
A part of our life	1	Exam	1	Point of view	1

Apple	1	Explanation	1	Question with shapes	1
Art of abstract thinking	1	Everything	3	Reflection	1
Astronaut	1	Formula	1	Science	9
Baby	1	House	1	Sleepless night	1
Balance	2	Human-being	1	Soul	1
Building block	1	Imagination	1	Source of life	1
Body of events	1	Inattentiveness	1	Space	1
Body of rules	1	Kid	1	Television	1
Body of systems	1	Light velocity	1	The system of principles	1
Boredom	1	Life / life itself	7	To astonish	1
Breath	1	Life tree	1	To see sth from a different perspective	1
Cartooon hero	1	Love	1	To wonder	1
Change point	1	Magnetic force	1	Tree	1
Chinese letters	1	Maths	1	Triple dot (...)	1
Clock	1	Meal	1	To Write	1
Compass	2	Mine	1	Wave (water wave)	1
Complete	1	More than the sight of the matter	1	Weight change	1

As seen in Table 1, 63 different metaphors for the concept of physics have been produced by the teacher candidates. Also, it is seen that "science" and "life/life itself" are the most expressed metaphors.
Metaphors that the teacher candidates have used for the concept of "Physics", paying attention to the explanations made for these metaphors, have been gathered in 8 categories in terms of their common properties and these formed categories have been presented in Table 2.

Table 2. Categories Formed on The basis of the Metaphors That Teachers Have for the Concept of Physics

Categories/Themes	Metaphors	f	Quotation
1. Physics as the efforts of discovering/ understanding life	To see sth from a different perspective Compass (2) To wonder Eating-physics is like eating Meal Kid To astound Source of life Reflection Point of view	11	*-"Physics is like source of life.It is to live the life by understanding. Because we grasp the logic of all vital events thanks to physics." (T-58)* *-"Physics resembles eating. Because if you are hungry, physics provides you with explanation about the topic and it saturates you. Scientists' minds are always complicated about what to research and where to start for proof. When we sit down to a meal, we ask as "table is full, which shall I eat first?" Here, Physics makes you full if you are hungry." (T-34)*
2. Physics as the life itself/ physics as the reflection of life	Life/Life itself (5) Everything (2) House Nature Complete Life tree Space Breathe Oxygen Energy Body of events Balance Effect (2)	19	*-"Physics is like the oxygen in air. Because there are indications regarding physics in every environment we are in. Just as a human cannot live in anaerobic environment, nothing can occur without physics. The source of every field is physics." (T-59)* *-"Physics is like breath. Because you need it. You cannot live without it, it is everywhere in the life.It is the reason of life for human." (T-57)*
3. Physics as a developing-changing/endless science	Love Angel Soul Baby Inattentiveness Triple dot (...) Art of abstract thinking Apple More than the sight of the matter Imagination Clock Mine Science	13	*-"Physics is like triple dot. Because triple dot is the indication of the fact that there is continuation of something, the first dot views the matter, the second dot views the human-being and the third dot views the nature. Each of them has no end.It emerges that new and various inventions which confront us everyday or results which we know and accept as true are full of mistakes in fact. Physics is triple dot. Because it explains that what a human has not learned yet is limitless when compared to that a human has learned."(T-35)* *-"Physics is like a new-born baby. Because it grows,*

			develops, learns and teaches everyday. It sometimes falls down but stands up by developing." (T-46)
4. Physics as a stressful-abstruse subject	Chinese letters (understanding another language) Boredom Adrenaline Exam Sleepless night Wave (Water wave) Activity Plain paper	8	*-"Physics is Chinese letters written on the board for the student. Because it is complicated and difficult to understand."(T-26)* *-"Physics is not to make one's toilet for hours in a long journey. Because I sit with that discomfort and boredom in every physics lesson. When the lesson ends, I feel as if I jumped from cold water to hot water. (T-20)*
5. Physics as a funny subject	Astronaut Cartoon hero Question with shapes Television Change point	5	*-"Physics is like a cartoon hero. Because each character is a new and funny invention."(T-18)*
6. Physics as the body of correlated knowledge	Tree Explanation To write Human-being Science (2) Building block Balance	8	*-"Physics is like a human. Because there is a correlation between the topics of physics. The same as human body. When there is a problem somewhere in human body, the other parts of the body are also affected. For example, when someone has a headache, his/her stomach and nervous system starts to get affected. In Physics, too, when you don't know a topic, there occurs a disconnection through the learning of other topics." (T-11)* *-"Physics is like writing. Because each sentence is correlated with the previous sentence. In physics, too, each law, each formula and each topic is correlated with the previous one. Physics is a strategy. As we understand at the end of the writing, we grasp a tip of everything we see but we can't understand or comment at the end of the topic."(T-15)*
7. Physics as the development source of technology	Everything Life (2) A part of our life	4	*-"Physics is like life. Because everything that concerns people in our daily life has occurred thanks to physics. Communication, transportation... In the simplest term, transportation on the sea has been provided by coming up with the buoyancy of water. Physics has a role in everything affecting human life like phone we use, television we watch, coal we fire, natural gas we use. Just as how important water is for human life, physics is that valuable.(T-23)*
8. Physics as the source of scientific explanations	Science (6) Body of rules Body of systems Magnetic force Weight change Maths Formula Velocity speed System of principles	14	*-"Physics is a science. Because it offers proofs for us by testifying the accuracy of a piece of knowledge and finding its construction and solution." (T-9)*

As seen in Table 2, metaphors teacher candidates use for the concept of "Physics" have been gathered in 8 different categories in terms of their common properties and that teacher candidates perceive the concept of physics as "physics as life itself/physics as the reflection of life", "physics as the source of scientific explanations", "physics as a developing-changing/endless science and "physics as efforts of discovering/understanding life".

Also, it is seen that there are positive and negative analogies of teacher candidates for the concept of physics in these identified categories. The categories "physics as efforts of discovering/understanding life", "a funny subject", "the developing source of technology" and "the source of scientific explanations"

can be shown for the positive analogies of teacher candidates. Although there are negative analogies, it is also seen from the table that the number of teacher candidates who see physics as "a stressful-abstruse subject" is low.

DISCUSSION AND CONCLUSİONS

Metaphors that enable the understanding development regarding unknown phenomenon by comparing the abstract and complicated phenomenon with more concrete and experienced phenomenon (Ocak and Gündüz, 2006) are, on that sense, strong cognitive tools which can be used to understand and explain a phenomenon (Saban, Koçbeker and Saban, 2007). Within the scope of this study, too, metaphors have been used with the aim of revealing a picture regarding how science and technology teacher candidates perceive physics.

In the study, in spite of the fact that 63 different metaphors have been obtained regarding the concept of physics, the main goal is to reveal how the teacher candidates perceive physics by means of metaphors. A metaphor, in fact, is not the mentioned phenomenon itself but only the symbol of it and for that reason, a phenomenon does not match up one to one with a metaphor (Yob, 2003, cited in Semerci, 2007, p. 133). Because of this, metaphors gain meaning with explanations made and portrays us how the topic of metaphor (physics) is perceived. It is seen that metaphors produced within the scope of this study are gathered under 8 different categories/themes. As well as obtained findings' proving that many metaphors are necessary for the explanation of the concept of physics as a whole, revealing the correlations between the topic of metaphor (physics) and its source (for instance, sleepless night) in more than one dimension can be considered as a result of individuals' perceiving a phenomenon or concept in different ways. Obtained findings show that teachers perceive physics via many perspectives like "efforts of discovering/understanding life", "life itself/reflection of life", "a funny subject" and "a stressful-abstruse subject". Similarly, in the studies, too, which Saban (2003), Saban (2004), Saban et al. 2007 and Cerit (2008), Saban (2008) and Özdemir (2012), Saban (2009) have made with the aim of presenting the perceptions regarding the concepts "teacher", "school" and "student", it is seen that many metaphors have been produced and different categories/ themes based on these metaphors have revealed.

Findings show that among the 63 different metaphors identified for the concept of physics, the metaphors - "science" and "life/life itself"- have been expressed most. In addition, it can be expressed that the positive perceptions of teacher candidates about the concept of physics (physics as the life itself/ physics as the reflection of life, physics as a funny subject, physics as the development source of technology and physics as the source of scientific explanations) are more dominant in proportion to their negative perceptions (physics as stressful-abstruse subject).

Physics is the life itself (MEB, 2010) and individuals' grasping the relation of the events affecting their own living with the knowledge they get at school can contribute to their being scientific literate (Çepni, Ayas, Johnson and Turgut, 1997). By this means, individuals can develop a positive attitude for science understanding the value of science. It has been identified that a considerable part of science and technology teacher candidates see physics as "life itself/ the reflection of life" (19 person) and "efforts of discovering/understanding life" (11 person). This situation can be related to their knowledge and skills that they acquire at physics lesson. At the same time, perception types of science and technology teacher candidates for the concept of physics can be considered as the indication of what kind of attitudes they have toward the science of physics. In other words, it can be said that metaphors that teacher candidates have for the concept of physics are shaped depending upon the personal attitudes they develop at physics lesson. When viewed from this aspect, it can be considered that the attitudes of a large part of teacher candidates participating in the study are positive.

It has been seen that teacher candidates perceive the concept of physics as "the source of scientific explanations" (14 person) and "a developing-changing/endless science". This situation can be considered as an indication of teacher candidates' having information about the nature of scientific knowledge. Another main goal of physical sciences education is expressed as knowing the nature of physical sciences, understanding how the knowledge is acquired and perceiving that the knowledge in physical sciences is dependent on the known truths and it can change as new proofs are gathered (Çepni et al, 1997).

Also, even though it is seen that some of the teacher candidates (8 person) have expressed physics as "a stressful-abstruse subject", it is remarkable that this number is not so high. Physics is, in general meaning, seen as a lesson which is full of knowledge that is hard to understand, abstract, stack of formulas, theoretical, not directly related to the society and people or boring and unnecessary (Ahlgren and Walberfg, 1973; Whiteleg and Parry, 1999; Tekbıyık and Akdeniz, 2010). That this perception of teacher candidates who perceive physics as a funny or stressful-abstruse subject can be originated from the structure of the physics lesson that they have taken so far and the learning environment they are in

within the scope of this lesson must not be ignored. Especially, even not in much quantity, the consideration of physics lesson as a hard or boring and insignificant lesson by some part of teacher candidates can be thought to have negative effects upon their teaching activities that they will do while performing their professions in the future. For that reason, as the teacher candidates' perception types of physics can be dependent upon the knowledge, skills and attitudes that they acquire at physics lesson; identifying the metaphors that the teacher candidates have for the physics and paying attention to them can be helpful for instructors who teach the lesson within the scope of teacher training to give meaning to their own roles and responsibilities, too.

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