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Metaphors that prospective primary school teachers possess on the concept of 'mathematics'

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Abstract

The main purpose of this study is to reveal the thoughts that prospective teachers studying at the department of teaching mathematics at primary schools possess with respect to the concept of 'Mathematics' through metaphors. The study was carried out with 106 female and 44 male students, total of 150 prospective teachers, who study at Kocaeli University Educational Faculty, Department of Teaching Mathematics at Primary Schools, during the fall semester in the 2011-2012 academic year. The data for the study was obtained by having students complete the blanks in the sentence '*Mathematics is like …….*; *Because …….*'. The study had a descriptive nature, since it is an attempt to reveal an existing situation as it is. The metaphors developed by the participant prospective teachers on the concept of '*mathematics*' were analyzed and interpreted by using qualitative research methods under the positive, negative and conceptual categories. In this context, the perceptions of prospective teachers studying at the department of teaching mathematics at primary schools regarding the concept of mathematics provide different perspectives.

Keywords: Metaphor, mathematics, prospective mathematics teachers

1. Introduction

'Mathematics', which is defined as 'abstracted form of life', (De Corte, 2004) is a science of number and space. Baki and Bell (1997) defined mathematics as the analysis of all possible patterns. Mathematics, which is used for processing information and making inferences from this, and as an effective tool for solving problems, is a perfect assistant for understanding the world. There are structures (concepts) and relations in mathematics which is a structural system. All these existing concepts are called relations. For instance, line segment, points and line are related (Baykul, 2009). Mathematics is a system which consists of ideas and formulas that are developed as a process of successive abstractions and generalizations (New South Wales Department of Education and Australian Council for Educational Research, 1972). In this study, the way prospective teachers, who study at the department of teaching primary school mathematics, consider mathematics was analyzed using a metaphoric approach. In this sense, 'metaphor' is explained as stated below.

What is a metaphor?

Metaphor concept, which was developed in Lakoff and Johnson's study 'Metaphors We Live By' for the first time in 1980, is a material of thought, a form of human perception and not only a discourse figure but also at the same time a figure of thought (Lakoff & Johnson, 2005).

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Metaphor is rhetoric for embellishing the discourse and thinking style which pervade to an individual's way of understanding the world (Aydın, 2010). Metaphors can be used by individuals to understand an abstract and complex phenomenon as a powerful mental tool and to enable learning unknown things, keeping in mind those things we learned, and also recalling when necessary (Afacan, 2011). Three elements are discussed in metaphoric perceptions. For instance, when you say 'teacher is like a compass', a metaphor is used by loading the features of a compass to a teacher. The three pillars of metaphor were formed first by establishing an equivalence with the features of a compass, like showing direction, guiding and leading and by stating the source of metaphor that is 'compass' likened word finally by stating the subject of the metaphor that is 'teacher' the imitative word (Forceville, 2002; quoted from Saban, 2004). In this study, it is intended to reveal the perceptions of prospective teachers, who study at the department of teaching mathematics at primary schools, related to the 'mathematics' concept. In this sense, it is expected that this study will mirror and support both teachers and new researchers to develop.

The answers to the following questions will be sought within the framework of analysis of the perception of prospective teachers studying at the department of teaching mathematics at primary schools related to the concept of mathematics through metaphor analysis.

1. What are the metaphors that prospective primary school mathematics teachers possess related to the concept of 'mathematics'?
2. What are the positive metaphors that prospective primary school mathematics teachers possess related to the concept of 'mathematics'?
3. What are the negative metaphors that prospective primary school mathematics teachers possess related to the concept of 'mathematics'?
4. How metaphors that prospective primary school mathematics teachers possess related to the concept of 'mathematics' can be classified under conceptual categories in terms of common features?

2. Method

2.1. Research Design

This study is a descriptive study in screening model.

2.2. Working Group

The participants of this research consist of students, who study at the department of teaching mathematics at primary schools, at Kocaeli University, during the spring semester in 2011-2012 academic year. 44 (29,33%) male and 106 (70,67%) female, in total 150 students, participated in this study.

2.3. Data Collection Tools, Collecting Data and Data Analysis

The questionnaires containing the statement of *'Mathematics is like …….; Because ……'* was distributed to the students and students were asked to write down the object that mathematics was associated with in the first blank field and to write the reasons why it was associated with that object in the second blank field. Total of 150 prospective mathematics teachers responded to the questionnaire. The metaphors, which were written by students, was read and reviewed one by one, and each metaphor was analyzed in terms of *(1) the subject of the metaphor, (2) the source of the metaphor* and *(3) the relationship between the source and the subject of the metaphor*.

3. Findings and Comments

In this section, findings and comments obtained through the analysis of metaphors developed by the participants related to the concept of 'mathematics' and explanations relating to their rationale for writing that metaphor are involved.

3.1. Metaphors created by participants related to the concept of mathematics

Nine metaphors created by participants related to the concept of 'mathematics' out of 150 were excluded from the study since a sound argument related to corresponding object was not stated. Invalid and unaccepted metaphors are; 'required, art, a long journey, chess, eating dessert after meal, love, science window and building'. The study continued with remaining 141 valid metaphors. It was seen that 91 different metaphors were created within total of 141 metaphors related to the concept of mathematics. Metaphors that were created can be found in Table 1.

Table 1. All metaphors that participants created related to the concept of 'Mathematics'

Rotation Number	Metaphor	f	%	Rotation Number	Metaphor	f	%	Rotation Number	Metaphor	f	%
1	Life	9	6,38	32	Subconscious	1	0,71	62	Blind Node	1	0,71
2	Riddle	7	4,96	33	Building	1	0,71	63	Lego	1	0,71
3	Game	6	4,26	34	A Blank Page	1	0,71	64	Funfair	1	0,71
4	Water	6	4,26	35	Blank	1	0,71	65	Obligation	1	0,71
5	Love	4	2,84	36	Can	1	0,71	66	Music	1	0,71
6	Key	3	2,13	37	Che Guevera	1	0,71	67	Pomegranate	1	0,71
7	Sun	3	2,13	38	Washing Machine	1	0,71	68	River	1	0,71
8	Tree	2	1,42	39	Raw meat	1	0,71	69	Note	1	0,71
9	Computer Game	2	1,42	40	Bottomless Pit	1	0,71	70	Oxygen	1	0,71
10	Universe	2	1,42	41	Nature	1	0,71	71	Market Basket	1	0,71
11	Air	2	1,42	42	Domino	1	0,71	72	Soap Opera	1	0,71
12	Light	2	1,42	43	Node	1	0,71	73	Puzzle	1	0,71
13	Human	2	1,42	44	World	1	0,71	74	Beard	1	0,71
14	Book	2	1,42	45	Film	1	0,71	75	Chess	1	0,71
15	Maze	2	1,42	46	Everything	1	0,71	76	Vegetable Soap	1	0,71
16	Breath	2	1,42	47	The Foundation of Everything	1	0,71	77	Affection	1	0,71
17	Money	2	1,42	48	Calculator	1	0,71	78	Darling	1	0,71
18	Clock	2	1,42	49	Hypermarket Basket	1	0,71	79	Cold Water	1	0,71
19	Art	2	1,42	50	Hobby	1	0,71	80	Eternal sea	1	0,71
20	Ivy	2	1,42	51	Need	1	0,71	81	Eternity	1	0,71
21	Space	2	1,42	52	Internet	1	0,71	82	Under water	1	0,71
22	Living	2	1,42	53	Name	1	0,71	83	Sudoku	1	0,71
23	Star	2	1,42	54	Top Brand Car	1	0,71	84	Poem	1	0,71
24	Alcohol	1	0,71	55	Cosmos	1	0,71	85	Technology	1	0,71
25	Complicated	1	0,71	56	Pencil	1	0,71	86	A tropical Fruit	1	0,71
26	Making Honey by Bee	1	0,71	57	A Complicated Street	1	0,71	87	Salt	1	0,71
27	Aroma	1	0,71	58	A Chaotic Neural Node	1	0,71	88	Outer Space	1	0,71
28	Fishing	1	0,71	59	Cat	1	0,71	89	Cherry	1	0,71
29	Playing Drum	1	0,71	60	Girl	1	0,71	90	Recently Learned Language	1	0,71
30	Baby	1	0,71	61	A Locked Door	1	0,71	91	Chain	1	0,71
31	Brain	1	0,71								
Total										**141**	**100**

Repetition frequency of metaphors varies between 1 and 9. The most frequently repeated metaphor is 'life', which was created by 9 participants. The metaphor of 'Life' is followed by the metaphor of 'Riddle', which was created by 7 participants, and the metaphors of 'Game' and 'Water' were created by 6 participants. It can be seen that the frequently repeated metaphors are generally the positive ones. For example;

*[ ] ... 'Mathematics' is like **oxygen**, because it is crucial... [ ]*
*[ ] ... 'Mathematics' is like **key**, because it is used in each lesson... [ ]*
*[ ] ... 'Mathematics' is like **music**, because it is universal... [ ]*

3.2. Positive metaphors that participants created related to the concept of 'mathematics'

The rationale for the metaphors created was evaluated using the content analysis method. At the end of the evaluation, metaphors were categorized as positive and negative. Positive metaphors' frequency of repetition varies between 1 and 10. The most frequently repeated metaphor is the 'life'. This metaphor is followed by the 'Riddle' metaphor, which was created by 7 participants. Likewise, the 'Water' metaphor was created by 6 participants and the metaphors of 'Love' and 'Game' were created by 4 participants. It can be seen that the metaphors are usually associated with the things or concepts that emphasize the importance of mathematics in life. '*It is everywhere', 'learned by living', 'we live in it', 'There is nothing without mathematical calculation'* can be given as examples.

3.3. Negative metaphors that participants created related to the concept of 'mathematics'

It was seen that 24 participants created 21 negative metaphors related to the concept of mathematics. It was also seen that the most frequent metaphors were 'life', 'game' and 'human'. Metaphors were mostly associated with things or concepts that emphasize the difficulty and complexity of mathematics. '*It is complex and difficult to solve', 'you love it too much but if it is too painful',' it is bad', 'They are too hard to solve'* can be given as examples.

3.4. Categorizing metaphors that participants created related to the concept of 'mathematics'

At the categorization phase of the metaphors related to the concept of mathematics, all the metaphors created were taken into consideration. Metaphors that participants created for the concept of mathematics were grouped under six categories taking into consideration their common features and their close rationales as stated by the participants. These categories are '*The Universality of Mathematics', 'The Complexity of Mathematics', 'The Guiding Role of Mathematics', 'The Necessity for Mathematics', 'The Relation of Mathematics with other Subjects/Sciences' and ' Amusing Mathematics'*. All the other metaphors that could not be associated with others were grouped under the category of '*Other*'.

3.4.1. The Universality of Mathematics

It was seen that 22 participants focused on the metaphors that emphasize the universality of the mathematics. It was seen that 17 different metaphors were created related to the universality of the mathematics. The most frequently repeated metaphor was 'life'. When metaphors are analyzed, it can be seen that "mathematics exists in every field of life" is emphasized. '*There is no end', 'have neither beginning nor end', 'it is universal'* can be given as examples.

3.4.2. The Complexity of the Mathematics

It was seen that 15 participants focused on the metaphors that emphasize the difficulty and the complexity of mathematics. It was seen that 11 different metaphors were created. The metaphor of 'Life' was the most frequent metaphor. The metaphor of 'life' is followed by the metaphors of 'Human' and 'Maze', which were created by 2 participants. '*It is full of correct, incorrect and missing things and it is very complicated'*, '*it is very complex*', '*you cannot go out when you get into*' can be given as examples.

3.4.3. The Guiding Role of Mathematics

It was seen that 15 participants focused on the metaphors that emphasize the guiding role of the mathematics in the daily life. It was also seen that 12 different metaphors were created. The most frequently repeated metaphors were 'Light', 'Star' and 'Sun'. '*Brightens our lights', 'it helps us to place the number in our lives properly', 'improve yourself as long as you read'* can be given as examples.

3.4.4. The Necessity for Mathematics

It was seen that 18 participants focused on the metaphors that emphasize importance and necessity of mathematics. It was also seen that 12 different metaphors were created. The metaphor of 'water' that was created by 5 participants was the most frequently repeated metaphor. This metaphor is followed by the metaphors of 'air' and 'life', which were created by 2 participants. '*There would not be a life without water', 'we need in every field of life'* can be given as examples.

3.4.5. The Relationship of Mathematics with other Fields / Sciences

It was seen that 22 different metaphors were created. The most frequently repeated metaphor was the metaphor of 'riddle'. '*All the results follow each other'*, '*All the rings are interconnected'*, '*it includes everything'* can be given as examples.

3.4.6. Amusing Mathematics

It was seen that 17 participants focused on the metaphors that emphasize that mathematics is amusing and the need to be loved. It was seen that 9 different metaphors were created. The most frequently repeated metaphors were 'riddle' and 'love'. '*Entertaining*', '*You will enjoy as long as you deal with it'* and '*you always love it'* can be given as examples.

3.4.7. Other

It was seen that 27 participants associated the concept of mathematics with different metaphors. These metaphors, which were not included in other categories and were not associated among themselves, were grouped under the category of 'Other'. It was seen that 25 different metaphors were created. The most frequently repeated metaphor was the metaphor of 'Life'. '*You need to be patient', 'it does not look like anything', 'it makes sense, if it is compatible'* can be given as examples.

4. Conclusion, Discussion and Implications

It was seen that 82,98% of the participants created positive ideas in this study, whose purpose was to investigate the perceptions of prospective mathematics teachers, who study at the department of teaching mathematics at primary schools related to the concept of 'mathematics' through metaphors. The rest of the participants had negative ideas.

When conceptual categories were examined, it was seen that the participants mostly created metaphors suitable to the categories of 'the relationship with other fields/sciences (19, 5%)' and 'other (19, 5%)'. Concordantly, it appeared that they paid more attention to the subjects within mathematics and their relationship with other sciences. It was seen that they focused secondly on the universality of mathematics (15, 6%), thirdly on the necessity of mathematics (12.77%), fourthly on the amusing part of the mathematics and finally on the guiding role of the mathematics. As a conclusion, it can be said that mathematics is an amusing guide, which is related to other sciences, is universal and necessary in our daily lives.

This study can be repeated with different prospective teachers groups and can be carried out comparatively.

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