



METAPHORS ABOUT MATHEMATICS OF INDUSTRIAL VOCATIONAL HIGH SCHOOL STUDENTS

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Abstract

In recent years, industrial vocational high school students are located on the last steps in high school entrance exam. Hence, vocational high school students' entrance exam mathematics results are very low. Because of that, this research is aimed to reveal metaphorical thoughts of vocational high school students about "mathematics" through metaphors. A total of 160 students who were studying in a industrial vocational school in 2014-2015 academic year are asked to complete the phrase of "mathematical is like..... because....." with this aim. Students were given sheets and asked to write their thoughts by focusing on one metaphor. The data of the research was analyzed through content analysis method. The metaphors developed by these students were determined, classified and categorized at this stage. At the end of the study, a total of 36 valid metaphors were identified and they were classified under 9 different categories. Besides, according to the meaning expressed, these metaphors are grouped under the headings of positive, negative and both positive and negative by students. The results of the research indicated that more than half of the students think mathematics as a negative issue.

Keywords: Mathematics; Industrial vocational high school students; Metaphor.

INTRODUCTION

In recent years, after becoming compulsory in our country, the schooling rate in secondary education has increased. Students completing the first eight years of their education prefer different types of high schools according to scores they get from high school entrance examinations and their interests.

Among the purposes of the vocational and technical secondary education programs is preparing students for both life and work areas in the direction of their interests, desires and abilities (The Vocational and Technical Education Regulations, 2002: 25). The vocational and technical high schools train intermediate elements for many sectors varying from education to industry, from trade to technology and divide into types according to sectors for which they train elements. Individuals graduating from such kinds of high schools become capable of working in various occupations according to the area/branch they choose. Moreover, students graduating from these kinds of secondary education institutions get the right to transition to associate degree programs of universities without entering examinations according to the area/branch choices. In addition to having a



profession, their having the right to continue university when they graduate without being obliged to enter the general examinations seems to have increased the demand for these high schools.

In the 2014-2015 educational year, all the vocational high schools were gathered under the name of "Vocational and Technical Anatolia High School" with the aim of decreasing the variety of schools in the vocational and technical secondary education (MNE, the circular numbered 2014/8). However, this decision has newly started to be put into practice as it is understood from the dates. While there were different schools with many names such as health vocational high school, trade vocational high school, industrial vocational high school, etc. in previous years, these programs were combined under a single name in this educational year. Although there was a name change, it was announced in this circular that the education periods of high schools which are in service as connected to the General Directorate of Vocational and Technical Education and the rights and authorities of graduates would not change. Individuals graduating from these kinds of education programs have some rights to transition to higher education institutions especially related to their professions. Vocational and technical secondary education institutions do not only provide their students with the right to vocational schools without examinations, they also give those who prefer departments related to their professional areas extra points in the Examination for Transition to Higher Education (ETHE) and Undergraduate Placement Examination (UPE). However, if we look into the recent examination statistics of the Student Selection and Placement Center (SSPC), we observe that vocational high schools take place near the bottom in the distribution of the percentages of the students getting a score of 180 and over in the ETHE. It is observed that especially only 28%-30% of the students of industrial high schools, one of the vocational and technical high school types, can get a score of over 180, take place in the last steps of achievement ratings (SSPC 2014 - ETHE Statistics, SSPC 2013 - ETHE Evaluation, SSPC 2012-ETHE Statistics). The situation is not so different for UPE. In all the score types and especially in the score type of Mathematics and Science (MS), most of vocational high schools remained under the Turkey average (SSPC 2014-UPE Results, SSPC 2013-UPE Results).

There are many factors affecting educational achievements of individuals. We can mention perception, interest, attitude and anxieties among the psychological factors affecting failure. In this study, mathematical perceptions of vocational high school students whose mathematical achievements are low in general examinations will be examined. Within this scope, the method of metaphORIZATION will be used. Metaphor can be defined as "a strong mental mapping and modeling mechanism aiming to understand and structure individuals' own worlds" (Arslan & Bayrakçı, 2006: 103). In order to make a concept which is abstract for an individual a concrete one to have them better understand it and to reach from a known state to an unknown one, metaphors are used.

In education, many studies have been carried out to investigate into emotions, thoughts and opinions of participants via metaphORIZATION. In studies carried out especially on mathematics, different perceptions such as mathematical perception and mathematics teachers' perceptions were analyzed (Erdogan, Yazlik & Erdik, 2014; Guler, Akgun, Ocal and Doruk, 2012; Guner, 2013; Hangul, Gur & Kara, 2014; Oflaz, 2001; Saban, 2006; Sengul, Katranci & Cantimer, 2014). Most of these studies (Erdogan, Yazlik & Erdik, 2014; Guler, Akgun, Ocal and Doruk, 2012; Guner, 2013; Hangul, Gur & Kara, 2014; Oflaz, 2001) examined thoughts of students from different class levels about the concept of mathematics through the metaphor analysis. Of these studies, as a result of the one carried out by Erdogan, Yazlik and Erdik (2014), it was observed that about 77% of the mathematics education student teachers developed positive metaphors about the concept of mathematics. As a result of the study carried out by Guler et al. (2012), it was understood that 28 metaphors were developed by the secondary education mathematics student teachers in relation to the concept of mathematics and most of these metaphors were positive. Moreover, as a result of the study made by Guner (2013), 28 metaphors putting forward the opinions and thoughts of the participant elementary education mathematics, social studies and classroom teaching student teachers about mathematics were reached and these metaphors were gathered under the themes of '*mathematics is a joyful occupation*', '*mathematics is the life itself*', '*mathematics makes life difficult*' and '*mathematics facilitates life*'. Moreover, it was also reported within the scope of this study that a great majority of the elementary education mathematics student teachers described mathematics as the *life itself*. As a result of the study carried out by Hangul, Gur and Kara (2014) with the aim of revealing the secondary and high school students' thoughts about the concept of "mathematics" through the metaphors,



the metaphors created by the students about the concept of "mathematics" were gathered under 5 different conceptual categories in terms of common characteristics. These conceptual categories were *scope of mathematics, difficulty/easiness/nature of mathematics, necessity of mathematics, students' interests/attitudes and teachers' interests and attitudes*. Moreover, as a result of the study made by Oflaz (2001), too, the metaphors created by the elementary school students about mathematics were gathered under 6 categories. Most of these metaphors which the students created about the concept of mathematics were gathered under the category of *content of mathematics*. That the students regarded mathematics as infinite, full of incomprehensible problems and a difficult subject was put forward within the scope of the study. As it is seen, only one of these studies (Hangul, Gur & Kara, 2014) was carried out with high school students. However, not a study carried out with vocational high school students was found.

Different from those studies, in this study, it was aimed to examine the perceptions of vocational high school students with low mathematical success in general examinations about mathematics and reveal metaphors which they have about this matter. Hence, it was tried to understand the feelings and thoughts of the participant industrial vocational high school students about mathematics. Within this scope, it will be investigated into how vocational high school students metaphorize mathematics, under which categories can these metaphors be gathered and again if these metaphors shed light into reasons of low mathematical success levels of these students. Moreover, this study is important and different from other studies in that it examines metaphors which industrial high school students with low mathematical success levels have. Hence, this study will try to reveal the viewpoint of students at vocational high schools where students with low base points are placed about mathematics at the stage of transition from elementary and secondary school to high school. With these aspects, this study is considered to make a contribution to the field.

METHODOLOGY

Research Model

The answers which the industrial vocational high school students participating in this study gave to an open ended question addressed to themselves were analyzed by categorizing via using the qualitative data analysis methods. For this reason, this is a descriptive study based on qualitative data.

In this study, of the qualitative research designs, the "*phenomenology*" design was used. The phenomenology design covers studying on phenomena of which we are aware but about which we do not have a detailed understanding. It provides an opportunity to obtain individuals' opinions about a matter or an event and hence to get to know a phenomenon (Yıldırım & Şimşek, 2006: 75-77).

Study Group

The study group was composed of the 10th, 11th and 12th grade students taking education in the 2014-2015 educational year at an industrial vocational high school selected randomly from among the industrial vocational high schools in the province of Akşehir. 160 students from different class levels were included in the study. The students participated in the study voluntarily.

Data Collection Tools and Procedure

With the aim of revealing the participant students' mathematical perceptions, the students were given forms on which it reads "For me, mathematics is like because" and they were asked to fill in these forms. In the meantime, the students were asked to create a simile while filling in this form. Then, the students were also asked to explain why they created that simile. The students willing to participate in the study based on voluntariness completed the forms within a time period of average 15-20 minutes.

Analysis of the Data

In the analysis of the data obtained within the scope of the study, the content analysis method was used. In this content, the obtained data was transformed into systematic data and categories were formed.

The metaphors developed by the students were analyzed and interpreted in three stages: (1) Determination of the metaphors, (2) Classification of the metaphors and (3) Categorization of the metaphors. In this scope, firstly

the forms filled by the students were read by the researcher before making any classifications. At the end of the first reading, 12 forms including no similes or no explanations in the 'because' part were excluded from the study. Then, at the stage of *determination of the metaphors*, the metaphors developed by the students were coded, listed in alphabetical order and 36 valid metaphors were ranked in accordance with their percentages. At the stage of *classification of the metaphors*, similar metaphors were found and categorized according to the characteristics which they shared with the other metaphors. Then, at the stage of *categorization*, the metaphors were analyzed in terms of their shared characteristics related with the concept of *mathematics*. At this stage, it was looked into how each metaphor conceptualized *mathematics*. Later, according to their common characteristics, the metaphors were gathered under 9 different categories. These categories were: *viewpoint, related to life, horrible, entertainment, esthetic, identified with human, requirement, incomprehensible subject and other*.

In the classification, quantification and categorization of the obtained data, the Microsoft Excel and SPSS 16.0 programs were used. In this scope, at the stage of quantification and categorization of the research data, percentage and frequency values were calculated.

FINDINGS

This section includes the research findings obtained as a result of the statistical analyses made with the aim of examining the metaphors which the participant students developed for mathematics and the interpretation made for these findings.

It was observed in the examinations made that 160 participant industrial vocational high school students created a total of 36 metaphors in relation to the concept of mathematics. The percentage and frequency values of the distributions of the metaphors which the participant students developed into these categories were given in Table 1.

Table 1: Metaphors Developed by Industrial Vocational High School Students for the Concept of Mathematics

No	Metaphor	f	%	No	Metaphor	f	%
1	A difficult subject	38	25.67	19	Reasonable	2	1.35
2	A boring subject	15	10.13	20	Teacher /individual	2	1.35
3	Life	12	8.10	21	Foreign language	2	1.35
4	A good thing	11	7.42	22	Load	2	1.35
5	Torture	7	4.72	23	Love	1	0.67
6	Game	6	4.05	24	Back-of-the-envelope calculation	1	0.67
7	A necessary subject	5	3.37	25	Sun	1	0.67
8	Nonsense	5	3.37	26	A nice-smelling flower	1	0.67
9	An unnecessary subject	4	2.70	27	Life exam	1	0.67
10	Beauty	4	2.70	28	Losing joy of life	1	0.67
11	A simple thing	3	2.08	29	A bad situation	1	0.67
12	Unreasonable	3	2.08	30	Lorry	1	0.67
13	Unloved person	3	2.08	31	Money	1	0.67
14	Alcoholic drink	2	1.35	32	Clock	1	0.67
15	Puzzle	2	1.35	33	Health	1	0.67
16	A child's toy	2	1.35	34	World of numbers	1	0.67
17	Illness	2	1.35	35	Zombie	1	0.67
18	Dark cemetery	2	1.35	36	Waste of time	1	0.67

When Table 1 was examined, it was observed that an important part of the participant industrial vocational high school students (25.67%) described mathematics as *a difficult subject*, a part of them (10.13%) as *a boring*

subject and a part of them (8.1%) as *life*. This indicates that an important part of the students had a negative perception about the concept of mathematics.

Then, these metaphors which the high school students developed were divided into 9 categories. These categories related to the developed metaphors were *viewpoint*, *related to life*, *horrible*, *entertainment*, *incomprehensible subject*, *requirement*, *esthetic*, *identified with human* and *other*.

Table 2: Distribution of the Metaphors Created for the Concept of Mathematics into Different Categories

Categories	Metaphors	Number of Metaphors	F	%
Viewpoint	A difficult subject, a boring subject, a good thing, a necessary subjects, an unnecessary subject, a simple thing, a disgusting situation, nonsense, reasonable, unreasonable	10	87	58.78
Related to life	Life, life examination, losing joy of life, a waste of time	4	15	10.16
Horrible	A dark cemetery, zombie, torture, load, illness	4	14	9.47
Entertainment	Game, puzzle, alcoholic drink	3	10	6.75
Esthetic	Beauty, a nice-smelling flower	2	5	3.37
Identified with human	Unloved person, mathematics teacher	2	5	3.37
Other	Clock, lorry, back-of-the-envelope calculation, a child's toy	4	5	3.37
Requirement	Health, love, money, sun	4	4	2.70
Incomprehensible subject	Foreign language, world of numbers	2	3	2.03
Total		36	148	100.00

When the pieces of information given in the above table was examined, it was understood that more than half of the metaphors (58.78%) which the participant students created for the concept of mathematics were the ones included in the category of *viewpoint*. In the category of *viewpoint*, the students stated their ideas about the subject of mathematics. As it is understood from the metaphors, in this category, the metaphors describing mathematics as difficult, boring, unnecessary are more in number. The statements of "*For me, mathematics is a difficult subject because I do not have a numerical aptitude.*" and "*For me, mathematics is a boring subject because I do not understand, and time wears away.*" are the examples from the students' answers. The common point of the metaphors (10.16%) belonging to the category of *life* taking place in the second rank is their including opinions about that mathematics is like the life itself, and not only indispensable but also difficult. Although mathematics includes comments like indispensable, necessary, as it is understood from the metaphors of losing joy of life and a waste of time, they rather represent a negative image. Here are some student answers about this matter: "*For me, mathematics is like life. For we all need mathematics in every part of our life.*", "*For me, mathematics is like a life exam. For if I get a low mark from mathematics, it plays on my life.*" If we look at what these students wrote, it is observed that although they fail the course, they are aware of the place of the course in school life and real life. The metaphors included in the category of *horrible* (9.47%) emphasize that mathematics is a frightening and tension-creating course in the eye of students. The students described mathematics as torture and put its frightening aspect into words with the metaphors of cemetery and zombie. A student writing down the metaphor of torture wrote these: "*For me, mathematics is like torture. For too many operations are done, it includes complicated operations.*" With three metaphors included in the category of *entertainment* (6.75%), the students emphasized the enjoyable aspect of mathematics. They likened doing mathematics to playing a game or described it as solving a puzzle. One of the students' statements classified in this category is this "*For me, mathematics is like a puzzle. For me, solving questions, equations is like solving a puzzle.*"

In the category of *esthetics* (3.37%), it can be stated that there is an emphasis on the esthetic aspect of mathematics. For the students made the comparisons of beauty and a nice-smelling flower and stated in the

explanation part that they enjoyed occupying with mathematics. The reason why the classification of *identified with human* was made (3.37%) was the formation of the metaphors included in this category through likening the metaphors to some humans. Under the heading of this category, the students either gave the names of those whom they did not like or the statements of the students using the names of their mathematics teachers as metaphors were taken into the scope. A student wrote these: “*For me, mathematics is like F... Y... For like him/her, it is a good course. All the courses s/he teaches are enjoyable.*” Moreover, the common characteristic of the metaphors included in the category of *requirement* (2.70%) was the emphasis made on the necessity of mathematics. The students explained that they required mathematics after the “because” part, too. It can be thought like health, like sun; its absence cannot be imagined. However, the least number of metaphors which these students created about mathematics were the ones related to the category of *incomprehensible subject*. Of the metaphors included in the category of *incomprehensible subject* (2.03%), the metaphor of foreign language makes an emphasis on the incomprehensibility of mathematics. The students creating this metaphor wrote these: “*For me, mathematics is like a foreign language. For I do not understand it at all.*” Under this category, another student described mathematics as a separate universe, the world of numbers, too. However, the metaphors included in the category of *other* were lorry, clock, back-of-the-envelope calculation and child's toy. With the metaphor of lorry, it was stated that those who knew how to do mathematics would love the course, but those who did not would fall down. With the metaphor of clock, it was emphasized that mathematics is a cumulative course continuing interrelatedly. Moreover, by comparing it to the back-of-the-envelope calculation, it was aimed to state that mathematics is easy and necessary for daily chores. And the metaphor of child's toy was created with a sentence continuing with the statement that mathematics is very easy.

As it is seen from the above explanations, the answers from the participant industrial high school students are various and contradictory. Because of individual differences, it is inevitable that they have different attitudes toward the course depending on their interests. Since the purpose of this study was to reveal the mathematical perceptions of the industrial vocational high school students, in this section, the metaphors were re-explained under the categories of positive, negative and both positive and negative according to the explanations in the “because” part. In the table given below, the positive metaphors which the students developed for the concept of mathematics are listed.

Table 3: Positive Metaphors Created for the Concept of Mathematics

No	Metaphors	f	%	No	Metaphors	f	%
1	A good thing	11	7.42	8	Reasonable	2	1.35
2	Game	6	4.05	9	Money	1	0.67
3	A necessary course	5	3.37	10	Health	1	0.67
4	Beauty	4	2.70	11	Back-of-the-envelope calculation	1	0.67
5	A simple thing	3	2.08	12	Sun	1	0.67
6	Puzzle	2	1.35	13	A nice-smelling flower	1	0.67
7	A child's toy	2	1.35		Total	40	27.02

As a result of the analyses, it was observed that the industrial vocational high school students created a total of 13 metaphors stating positive perceptions about the concept of mathematics. In this scope, it was understood that the metaphors which 27.02% of the participant students created for the concept of mathematics were positive. In these categories, the students stated that they found mathematics necessary and entertaining, simple, good and nice and loved the course of mathematics. Moreover, in the metaphors of *reasonable* and *necessary*, it was observed that the students were aware that the course is associated with every area in life. Generally, it can be stated that the individuals creating these metaphors loved the course of mathematics. The students had both positive and negative metaphors about the concept of mathematics. Moreover, in Table 4 given below, these negative metaphors which the students created in relation to the concept of mathematics are listed.

Table 4: Negative Metaphors Created in relation to the Concept of Mathematics

No	Metaphors	f	%	No	Metaphors	f	%
1	A difficult course	38	25.67	9	Illness	2	1.35
2	A boring course	15	10.13	10	A dark cemetery	2	1.35
3	Torture	7	4.72	11	Foreign language	2	1.35
4	Non-sense	5	3.37	12	Load	2	1.35
5	An unnecessary course	4	2.70	13	A horrible situation	1	0.67
6	Unreasonable	3	2.08	14	Losing joy of life	1	0.67
7	An unloved person	3	2.08	15	A waste of time	1	0.67
8	Alcoholic drink	2	1.35	16	Zombie	1	0.67
Total						89	60.14

As a result of the analyses, it was observed that the high school students created a total of 16 metaphors stating their negative perceptions about the concept of mathematics. In this scope, it was understood that the metaphors which 60.14% of the participant industrial vocational high school students created for the concept of mathematics were negative. In this category and in general sense, with its frequency and percentage values, the metaphor used by the students most frequently was the metaphor of *a difficult course*. 25.67% of the students described mathematics as a difficult-to-understand and succeed course. When the explanation parts of the metaphors included in this category were examined, it was understood that the participant high school students had low interest in the course, did not love the course, were afraid of the course and, for this reason, created these metaphors. Moreover, in these metaphors, there are complaints about the number of lesson hours of mathematics and doing complicated mathematical operations. However, a great majority of the students creating the metaphors of *boring*, *difficult* and *unnecessary* (10.13%, 25.67% and 2.7%, respectively) stated that they would not need mathematics in their future jobs. In other words, these students found the teaching of this course unnecessary because of thinking that they would not use it anywhere.

The classifications of both positive and negative metaphors were made again by considering the statements which the students wrote after the "because" part in the text addressed to them. And the findings belonging to this category were listed in Table 5.

Table 5: Students' Metaphors Stating both Positive and Negative Perceptions

No	Metaphors	f	%	No	Metaphors	f	%
1	Life	12	8.10	5	Lorry	1	0.67
2	Teacher / Individual	2	1.35	6	Clock	1	0.67
3	Love	1	0.67	7	World of numbers	1	0.67
4	Life exam	1	0.67				
Total						18	12.16

The common point of the metaphors was their answering both negative and positive statements about mathematics at the same time. As a result of the analyses, it was observed that 12.16% of the participant industrial vocational high school students created a total of 7 metaphors stating both positive and negative perceptions about the concept of mathematics. In this scope, a great majority of the students (8.1%) wrote the metaphor of *life*. While a part of the students emphasized the necessity of mathematics with this metaphor, another part of them mentioned that mathematics was difficult and not loved.

CONCLUSION AND SUGGESTIONS

The vocational high school students are those who exhibit low performance in the general examinations held in Turkey and there are many reasons underlying this failure. And students' mathematical perceptions affect their mathematical achievements levels, too. For this reason, in this study, the metaphors which the industrial

vocational high school students created for the concept of mathematics were examined and, over these metaphors, these students' positive and negative thoughts about mathematics were revealed.

The participant high school students created a total of 36 metaphors within the scope of this study. Then, these metaphors were gathered under 9 different categories. These categories were *viewpoint, related to life, horrible, entertainment, esthetic, identified with human, requirement, incomprehensible subject* and *other*. Finally, the metaphors were also gathered under three main headings according to what the students wrote down in the "because" part of the forms addressed to them. These were *positive, negative and both positive and negative* metaphors. In this scope, while 27.02% of the participant students created positive and 12.16% created both positive and negative metaphors, 60.14% created negative metaphors. From here, it is understood that more than half of the students created negative metaphors about the concept of mathematics. This indicates that the mathematical images of the industrial vocational high school students were generally negative. These thoughts of theirs about the course may affect their success in the course of mathematics. And their thinking that they show no interest in or cannot do the course account for the unwillingness of these students having a negative thought about mathematics about taking the course and participating in lessons. In the continuation of the negative metaphors, such statements as "... because it is very boring course.", "... because we write too many things and do too many mathematical operations.", "...because I will become an electrician, where will I need mathematics?" , "... Because everybody has an area of specialization, who needs mathematics ..." were frequently encountered. This reached result does not overlap the results obtained in the study carried out by Erdoğan, Yazlık and Erdik (2014) with elementary school mathematics teachers and the one made by Güler et al., (2012) with secondary education mathematics student teachers that most of the students developed positive metaphors about the concept of mathematics. Moreover, the categories reached within this scope differ from some of the categories reached as a result of the study carried out by Hangül, Gür and Kara (2014) with secondary school and high school students.

It is clear that students also exhibit low success in the exams which they enter in the transition to high school for this type of high school. This being the case, they have difficulty in almost all the courses and mathematics comes in the lead of the courses in which they have difficulty. Many students stated that they wrote too many things and did too many mathematical operations in lessons. Another situation was that the course was described as boring. This may be changed, though partly, by giving place to different educational activities in math lessons. Lessons can be made more interesting by using presentations, videos, physical or imaginary manipulations and different materials about the subject. Moreover, the students' thinking that they will not use mathematics in their future occupations causes them to regard this course as unnecessary. However, there is mathematics on the basis of many professional programs (electric – electronic, information systems, motor, etc.) taught in industrial vocational high schools. However, among the purposes of the course of mathematics are having students "develop problem solving skills", "acquire mathematical thinking skills", "appreciate mathematics and mathematics education" (MNE, 2013). In other words, with these objectives, it was aimed to have students not only do operations with the subjects of mathematics but also acquire the ability to overcome daily life problems. It is also important that students should be made aware of these and, in math lessons in smaller classes, they should be made to anticipate that mathematics is associated with daily life and aware that mathematics is useful and valuable. And reaching such a result despite the practicing of course programs having undergone fundamental changes in recent years at schools in Turkey makes us consider that sufficient importance is not attached to the usefulness, importance and life relatedness of mathematics in elementary school classes or these types of information are insufficient in course programs and textbooks. About this subject, especially mathematics teachers have important responsibilities. Classroom and mathematics teachers can be made to put more emphasis on these matters in math lessons.

WJEIS's Note: This article was presented at 4th World Conference on Educational and Instructional Studies-WCEIS, 05-07 November, 2015, Antalya-Turkey and was selected for publication for Volume 6 Number 1 of WJEIS 2016 by WJEIS Scientific Committee.



REFERENCES

- Arslan, M. M., & Bayrakçı., M. (2006). Metaforik düşünme ve öğrenme yaklaşımının eğitim-öğretim açısından incelenmesi. *Millî Eğitim* 35(171), 100-108.
- Erdoğan, A., Yazlık, D.O., & Erdik, C. (2014). Mathematics teacher candidates' metaphors about concept of "mathematics". *International Journal of Education Mathematics, Science & Technology*, 2(4), 289-299.
- Güler, G., Akgün, L., Öçal, M.F., & Doruk, M. (2012). Preservice mathematics teachers' metaphors about mathematics concept. *Journal of Research in Education and Teaching*, 1(2), 25.
- Güner, N. (2013). Öğretmen adaylarının matematik hakkında oluşturdukları metaforlar. *E-Journal of New World Sciences Academy-Education Sciences*, 8(4),428-440.
- Hangül, T., Gür, H., & Kara, A. (2014). Comparing metaphors that middle school and high school students' possess about the concept of "mathematics". *The Journal of Academic Social Science Studies*, 25(1), 427-444.
- MEB (2002). Mesleki ve Teknik Eğitim Yönetmeliği. Retrieved on January 1, 2015 from http://mevzuat.meb.gov.tr/html/24804_0.html.
- MEB (2014). MEB 2014/8 sayılı Genelge. Retrieved on January 1, 2015 from http://mtegm.meb.gov.tr/meb_iys_dosyalar/2014_05/05032901_okuleitilii_genelge.pdf.
- Oflaz, G. (2011). İlköğretim Öğrencilerinin Matematik ve Matematik Öğretmeni Kavramlarına İlişkin Metaforik Algıları. Paper presented in the 2nd International Conference on New Trends in Education and Their Implications, 27-29 April, Antalya, Turkey.
- OSYS (2012). YGS Sayısal Bilgileri. Retrieved on January 2, 2015 from http://dokuman.osym.gov.tr/pdfdokuman/2012/OSYS/2012YGS_Sonuclari.pdf.
- OSYM (2013). LYS Sonuçları. Retrieved on January 1, 2015 from <http://www.osym.gov.tr/dosya/1-69292/h/2013-lyssayisabilgilerbasin.pdf>.
- OSYS (2013). YGS Değerlendirmesi. Retrieved on January 1, 2015 from http://dokuman.osym.gov.tr/pdfdokuman/2013/OSYS/2013-YGS-SonucAciklama_Sunum.pdf.
- OSYS (2014). YGS Sayılar Bilgileri. Retrieved on January 1, 2015 from <http://dokuman.osym.gov.tr/pdfdokuman/2014/OSYS/yerlestirme/2014-OSYS-YerlestirmeSonuclar%C4%B1nalliskinSayisabilgiler23072014.pdf>.
- OSYM (2014). LYS Sonuçları. Retrieved on January 1, 2015 from http://dokuman.osym.gov.tr/pdfdokuman/2014/LYS/2014_LYS_SB.pdf.
- Ortaöğretim İzleme ve Değerlendirme Raporu, 2013
http://ogm.meb.gov.tr/meb_iys_dosyalar/2014_02/14013735_ortaretimrapor2013.pdf, erişim tarihi: 1 Ocak 2015.
- Saban, A. (2004). Giriş düzeyindeki sınıf öğretmen adaylarının "öğretmen" kavramına ilişkin ileri sürdükleri metaforlar. *Türk Eğitim Bilimleri Dergisi*, 2(2).
- Şengül, S., Katrancı, Y., & Cantimer, G.G. (2014). Metaphor perceptions of secondary school students about "mathematics teacher" *The Journal of Academic Social Science Studies*, 25(1), 89-111.
- Yıldırım, A., & Şimşek, H. (2005). *Sosyal bilimlerde nitel araştırma yöntemleri* (5. basım). Ankara: Seçkin Yayıncılık.