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IMAGE OF THE HIGH SCHOOL STUDENTS TOWARDS MATHEMATICIANS

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Abstract
Aim of this study is identify how high school students see mathematicians by the pictures they visualized. In accordance with this purpose phenomenology pattern which is one of the qualitative patterns was used as a research pattern. The study was carried out with 150 volunteered high school students. The data collection tool to be used in this study consists of four parts. The first part includes questions to determine demographic characteristics of students, second part include drawing box prepared to define images of students towards mathematicians and open ended questions towards describing drawing, third part includes the presented options to define the image sources towards mathematicians and the fourth part includes open-ended questions to determine famous mathematicians and reasons. The images that students draw about mathematicians were analyzed by the content analyses method. It is believed that the results from at the end of the study will be helpful to training of mathematics teacher.

Keywords: Concept İmage, Mathematicians, Mathematics Education.

INTRODUCTION

The new generation growing up with rapid changes in science and technology are expected to keep pace with these changes, solve the problems they encounter and produce new information by looking at existing knowledge (Cermik, 2013). Therefore, the instructional programs are restructured in order to grow up individuals who can leap forward in science and technology. With the changes in math, science and technology programs, it is aimed to make students learn by search and discovery instead of memorizing scientific concepts, principles and theories (Korkmaz and Kavak, 2010). The main approach in this instruction program is growing up students “who think as scientist” (Turkmen, 2008). Besides that, the researchers conducted show that the perception of students towards scientists affect their attitude for science and their future career selections significantly (Hammrich, 1997; Finson, Riggs and Jesunathadas, 1999; Finson, 2002; Wyer, 2003). Therefore, many studies are done to see the thoughts of individuals about scientists and turn their negative images to positive ones (Chambers, 1983; Song and Kim, 1999; Gunsoulin, 2001; Finson, 2002; Wyer, 2003; Kavak, 2008; Kaya, Dogan and Ocal, 2008; Turkmen, 2008; Erkorkmaz, 2009; Korkmaz and Kavak, 2010; Medina-Jerez, Middleton and Orihuela-Rabaza, 2011; Yalcin, 2012; Cermik, 2013; Narayan et al., 2013). In these studies, similar findings with the image of students towards scientist are obtained, and it is determined that scientists are perceived generally as male, wearing teacher coat, with glasses, bearded, blowzy, busy with test equipment, working at laboratory and asocial people. However, in the study by Bodzin and Gehringer (2001) it is observed that a positive change in image of fourth and fifth grade students towards scientists is seen after the visit of scientists. In the study by Smith and Erb (1986), it is seen that a positive attitute of primary school students towards science and the place of women in science is seen after the visit of women scientists.

It is seen that even if many studies are conducted to determine the images of students, teacher candidates and teachers towards scientists, only a little number of studies are done to examine the images of students towards mathematicians (Picker and Berry, 2000; Rensaa, 2006; Piatek-Jimenez, 2008; Grevholm, 2010; Ucar et al., 2010; Aguilar et al., 2016). When the images towards mathematicians are examined, in the study by Picker and Berry (2000) which is conducted with students at the age of between 12-13 in United States of America,

United Kingdom, Finland, Sweden and Romania, it is seen that mathematicians are seen as poorly groomed, soap dodger, oppressive and threatening. In his study about the images of Norwegian students towards mathematicians, Grevholm (2010) stated that mathematicians are perceived as male, old, alone, generally with glasses and sometimes bearded ones. Piatek-Jimenez (2008), in his study which is conducted with five female students, conclude that mathematicians are clever, socially weak and thinking nothing than math. Aguilar and his colleagues (2016), in their study which is conducted with sixty three Mexican high school students, indicate that high school students see mathematicians generally as male, casual or official dressed and wear glasses in some situations. In addition to this, he stated that mathematicians are happy, clever, delighted in work and dote upon math. In our country, Ucar and his colleagues (2010) determined that mathematicians are ones who deal with numbers, asocial, alone, introverted, quiet and nervous people as a result of their study conducted with seventh and eighth grade students under the age of nineteen.

As a result of literature search, it is seen that only a few studies are conducted on how students see mathematicians in the world especially in our country. Though, according to Lim and Ernest (1999), if the students are expected to see math as an attractive field and pick up math as mathematicians, it is needed to reveal the thoughts of students towards mathematicians. Herewith, the negative images can be determined and ways to turn them into positive ones can be found. Therefore, in this study it is aimed to determine how high school students see mathematicians with reference to Picture in their minds

METHOD

The aim of this study is how high school students see Mathematicians regarding image come alive in their minds. For this purpose, phenomenology pattern which is a pattern of qualitative research pattern is used. Phenomenology pattern make us focus on phenomenon which we are aware but do not have a deep and detailed understanding (Yildirim and Simsek, 2006). In such kind of studies, it is aimed to reveal individual perceptions or perspectives related to a certain phenomenon.

Participants

This study was conducted with 150 high school students selected on a voluntary basis in Konya city center. 75 (50%) of participants are female and 75 (50%) are male students between the ages of 15-19 (average 17.3).

Data Collection

In this study, the Turkish version of a scale which was developed by Song and Kim (1999) based on Draw-A-Scientist Test (DAST) by Chambers (1983) is used as data collection tool. The parts, the mental images of students towards scientists and their perception of scientists around them which exist in original scale by Song and Kim (1999) are not used in this study and “mathematicians” term is used instead of “scientists” term in the original scale. The scale used in this study have four parts. The first part includes questions to determine demographic characteristics of students, second part include drawing box prepared to define images of students towards mathematicians and open ended questions towards describing drawing, third part includes the presented options to define the image sources towards mathematicians and the fourth part includes open-ended questions to determine famous mathematicians and reasons. During data collection process, first, the aim of study and where the data will be used issues are mentioned and afterwards the scale is given out to volunteer students. The practice lasted for 30 minute and students are guided if needed during practice.

Data Analysis

Each part of scale analyzed separately within itself and analysis are conducted by two experts in the field. In the second part, the drawings of students which picturize the mathematician image and the answers given to open ended questions towards describing these drawings by students are investigated and coded then each was analyzed separately using content analysis method. After that, the repeater codes are categorized then thematized. The data dissociated according to obtained themes are shown in tables with frequency and percent values reflecting gender differences providing that each theme is separate. In the third part of the scale, the options given to determine image resources of students about mathematicians are analyzed through their choices and the image resource of students about mathematicians is determined. This data is again shown in a table with frequency and percent values reflecting gender differences. In the last part, the answers

given by students to the open-ended questions asked to determine famous mathematicians and reasons are read one by one and, as in second part, content analysis is used. The data dissociated according to obtained theme are shown in tables with frequency and percent values reflecting gender differences providing that each theme is separate.

Yildirim and Simsek (2006) state that a detailed report about how the data and the results obtained is an important criterion for validity in qualitative researches. The data collection and analysis processes are explained in a detailed way within this context. In order to provide reliability in this study, the data were analyzed separately by two experts and then codes and categories determined. Comparing the analysis of these two experts in the field, the number of overlapping and nonoverlapping codes are determined. The reliability level is calculated as 96% using (Reliability = number of overlapping/(number of overlapping+nonoverlapping)) formula (Miles and Huberman, 1994). According to Miles and Huberman, if the value obtained from this formula is 90% or over, it is enough for reliability. Besides, the drawings of participants are presented to provide reliability and validity while commenting themes obtained from data.

FINDINGS

The findings of this study considering the subsections in the scale are given below.

Mathematician Images in Minds of Students

When the drawings in which students picturize a typical mathematician image and the answers given to open ended questions asked to determine the image resources of students about mathematicians are investigated, it is seen that 146 students out of 150 students draw one of their mathematics teacher and 4 of them draw a mathematics teacher. 2 of these 4 students draw themselves as a mathematician and the other 2 draw a mathematician working at university.

As a result of the data analyzed in this part of the scale, the themes such as the physical characteristics, personal characteristics, age, gender, the material used, the environment, interest fields and alternative symbols of a mathematician are obtained. Thereafter, the data dissociated according to obtained themes are shown and interpreted in tables with frequency and percent values reflecting gender differences.

Table 1: Physical Characteristics of Mathematicians in Minds of Students

Physical Characteristics	Female		Male		Total	
	f	%	f	%	f	%
Wearing teacher coat	4	5.3	7	9.3	11	7.3
Wearing Suit/Stylish	25	33.3	19	25.3	44	29.3
Dress sporty	8	10.6	1	1.3	9	6.0
Well groomed	31	41.3	25	33.3	56	37.3
Poorly groomed/soap dodger	4	5.3	11	14.6	15	10.0
Wearing glasses	21	28.0	16	21.3	37	24.6
Wearing earring	1	1.3	1	1.3	2	1.3
Bearded	4	5.3	17	22.6	21	14.0
Mustached	3	4.0	12	16.0	15	10.0
Atrichous	6	8.0	12	16.0	18	12.0
Curly haired	4	5.3	3	4.0	7	4.6
Long haired	2	2.6	1	1.3	3	2.0
Blowzy	4	5.3	4	5.3	8	5.3
Spicky haired	10	13.3	5	6.6	15	10.0
Fat/Bellied	2	2.6	16	21.3	18	12.0
Thin	4	5.3	8	10.6	12	8.0
Tall	4	5.3	0	0.0	4	2.6
Short	1	1.3	0	0.0	1	0.6
Cheerful	14	18.6	4	5.3	18	12.0

Thoughtful	4	5.3	1	1.3	5	3.3
Bewildered	1	1.3	1	1.3	2	1.3
Scowling/Serious	5	6.6	3	4.0	8	5.3
Tired	2	2.6	6	8.0	8	5.3
Energetic	2	2.6	1	1.3	3	2.0
Witch	1	1.3	0	0.0	1	0.6
Satan	3	4.0	1	1.3	4	2.6
Fiend	1	1.3	0	0.0	1	0.6
Creature/Monster	1	1.3	1	1.3	2	1.3
Angle	1	1.3	1	1.3	2	1.3
Superman	0	0.0	1	1.3	1	0.6
Robot	1	1.3	1	1.3	2	1.3
Weight Lifter	0	0.0	1	1.3	1	0.6

When Table 1 which is about physical characteristics of mathematicians is examined, while 29,3% see mathematician wearing suit, 7,3% see with teacher coat and 6% see as dressed sporty, 37,3% of students see them as well-groomed but 10% see them poorly groomed. 24,6% of students see mathematician with glasses, 14% see them bearded, 10% see them mustached, 12% see them atrichous, 10% see them spicky haired, 12% see them fat and 8% see them thin. In addition to these, 12% of students see mathematicians cheerful, 5,3% see them scowling and 5,3% see them as scary figures such as witch, satan, fiend and monster.

When the physical characteristics of mathematician examined according to gender, when compared to male students, female students mostly (41,3%) see mathematicians well groomed, 10,6% see them dressed sporty and 18,6% see them cheerful. When compared to female students, male students (14,6%) see mathematicians as poorly groomed in a high level, 22,6% see them bearded, 16% see them mustached, 24,3% see them fat and bellied. Apart from this, while 8% of female students pictured mathematicians as scary figures such as witch, satan, monster, fiend, this ratio is 2,6% for male students.

Table 2: Personality Characteristics of Mathematicians in Minds of Students

Personality Characteristics	**Female**		**Male**		**Total**	
	f	**%**	**f**	**%**	**f**	**%**
Clever	9	12.0	11	14.6	20	13.3
Successful	1	1.3	3	4.0	4	2.6
Devoted to mathematics	7	9.3	5	6.6	12	8.0
Explaining everything with mathematics	1	1.3	1	1.3	2	1.3
Researcher	4	5.3	0	0.0	4	2.6
Angry	5	6.6	7	9.3	12	8.0
Calm	3	4.0	3	4.0	6	4.0
Excited	3	4.0	1	1.3	4	2.6
Responsible	10	13.3	4	5.3	14	9.3
Irresponsible	5	6.6	13	17.3	18	12.0
Ambitious	1	1.3	2	2.6	3	2.0
Sophisticated	1	1.3	1	1.3	2	1.3
Entertaining/humoristic	12	16.0	16	21.3	28	18.6
Boring	9	12.0	3	4.0	12	8.0
Serious	3	4.0	0	0.0	3	2.0
Merciless	9	12.0	6	8.0	15	10.0
Selfish	9	12.0	6	8.0	15	10.0

Insightful / tolerant	10	13.3	5	6.6	15	10.0
Helpful	13	17.3	12	16.0	25	16.6
Concerned	2	2.6	6	8.0	8	5.3
Unconcerned	2	2.6	2	2.6	4	2.6
Happy	1	1.3	1	1.3	2	1.3
Unhappy	3	4.0	0	0.0	3	2.0
Respectful	1	1.3	1	1.3	2	1.3
Self-confident	2	2.6	2	2.6	4	2.6
Idealist	1	1.3	1	1.3	2	1.3
Hardworking	12	16.0	4	5.3	16	10.6
Lazy	1	1.3	5	6.6	6	4.0
Careful	3	4.0	0	0.0	3	2.0
Careless	0	0.0	4	5.3	4	2.6
Disciplined	4	5.3	1	1.3	5	3.3
Impatient	0	0.0	1	1.3	1	0.6
Patient	1	1.3	0	0.0	1	0.6
Energetic	2	2.6	1	1.3	3	2.0
Sensible	2	2.6	3	4.0	5	3.3
Fair	3	4.0	4	5.3	7	4.6
Insidious	0	0.0	2	2.6	2	1.3
Affectionate	9	12.0	5	6.6	14	9.3
Popular	4	5.3	4	5.3	8	5.3
Respected	1	1.3	2	2.6	3	2.0
Social	1	1.3	5	6.6	6	4.0
Asocial	11	14.6	2	2.6	13	8.6
Weird	2	2.6	2	2.6	4	2.6
Absent –minded	0	0.0	1	1.3	1	0.6
Threatening with score	5	6.6	0	0.0	5	3.3
Prone to violence	1	1.3	1	1.3	2	1.3
Offensive	0	0.0	7	9.3	7	4.6
Boaster	3	4.0	2	2.6	5	3.3
Prejudiced	2	2.6	3	4.0	5	3.3

When Table 2 which shows the personal characteristics of mathematicians is examined, it is seen that 13,3% of students see mathematicians clever, 10,6% see them hardworking, 8,0% see them devoted themselves to math, 9,3% see them responsible and 12% see them irresponsible. 18,6% of students see mathematicians entertaining/humorous, 9,3% see them affectionate, 16,6% see them helpful and 10% see them insightful/tolerant on the other hand 10% see them merciless, 10% see them selfish, 8% see them angry and 8% see them boring. In addition to these, 8,6% see mathematicians asocial and 4% see them social.

When the personal characteristics of mathematicians is examined according to gender; when compared to male students, female students (13,3%) see mathematicians responsible, 16% see them hardworking, 14,6% see them asocial and 12% see them boring. When compared to female students, male students (17,3%) see mathematicians irresponsible, 6,6% see them lazy and in the same rate they are seen social. Apart from this, only female students (2,6%) see them researcher, 3,3% see them threatening with score, 2% see them serious, 2% see them unhappy. In the same way, only male students (2,6%) see them careless and 4,6% see them offensive.

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Figure 1: Examples from Drawings of Students

Table 3: Gender of Mathematicians in Minds of Students

Gender of Mathematicians	Female		Male		Total	
	f	%	f	%	f	%
Female	20	26.6	11	14.6	31	20.6
Male	50	66.6	63	84.0	113	75.3
Unknown	5	6.6	1	1.3	6	4.0

As it is seen in Table 3, 75,3% of students picture mathematician as male while 20,6% pictured as female. The gender in figures drawn by 4% of students could not be determined. Because these students used satan, monster and robot figures and also they didnot specify their gender in open ended questions. While the male mathematician figure is seen in drawings of male students in the amount of 84%, this ratio is 66,6% for female students. Female mathematician figure is generally seen in drawings of female students. 26,6% of female students and 14,6% of male students used female mathematician figure in their drawings. It is obvious that most of the students perceive the gender of mathematician as male.

Table 4: Age of Mathematicians in Minds of Students

Age of Mathematicians	Female		Male		Total	
	f	%	f	%	F	%
10-19	1	1.3	1	1.3	2	1.3
20-29	19	25.3	9	12	28	18.6
30-39	32	42.6	37	49.3	69	46.0
40-49	15	20.0	18	24.0	33	22.0
50-59	4	5.3	5	6.6	9	6.0
60-69	0	0.0	3	4.0	3	2.0
Of all ages	4	5.3	2	2.6	6	4.0

When the findings about the age of a mathematician given in Table 4 are analyzed, it is seen that 18,6% of students see mathematicians at between the age of 20-29, 46% see them between the age of 30-39 and 22%

see them between the age of 40-49 ages. Hence, it can be concluded that students perceive mathematicians as people at the age of 20-49 in general. When the findings about the age of mathematician is analyzed in terms of genders, it is concluded that when compare the male students, female students see mathematicians between the ages of 20-29 while the male students see them between the age of 30-49.

Table 5: The Materials Used by Mathematicians in Minds of Students

The Materials Used by Mathematicians	Female		Male		Total	
	f	%	f	%	F	%
Pen/Pencil	15	20.0	8	10.6	23	15.3
Book	6	8.0	5	6.6	11	7.3
Exam Paper	2	2.6	8	10.6	10	6.6
Paper	3	4.0	4	5.3	7	4.6
Pocketbook	6	8.0	1	1.3	7	4.6
Notebook	1	1.3	0	0.0	1	0.6
Bag	2	2.6	3	4.0	5	3.3
Ruler	0	0.0	2	2.6	2	1.3
Abacus	0	0.0	1	1.3	1	0.6
Computer	1	1.3	1	1.3	2	1.3
Teaching stick	1	1.3	1	1.3	2	1.3
Triangle Ruler	0	0.0	1	1.3	1	0.6
Tobacco Pipe	0	0.0	1	1.3	1	0.6
Rosary	0	0.0	1	1.3	1	0.6
Guitar	1	1.3	0	0.0	1	0.6
Stick	0	0.0	3	4.0	3	2.0
Walking stick	1	1.3	0	0.0	1	0.6
Flambeau	1	1.3	0	0.0	1	0.6
Devil's pitchfork	3	4.0	1	1.3	4	2.6

When Table 5 is examined, the materials used by mathematicians in drawings of students are pencil by 15,3%, books by 7,3%, exam papers by 6,6%, papers by 4,6%, pocketbook by 4,6%, bag by 3,3% and computer by a lower ratio (1,3%). When the materials used by mathematicians in drawings of students are examined according to gender, 20% of students draw pencil, 8% draw pocketbook, 8% draw books, 4% draw papers and 4% draw the devil's stick. 10,6% of male students draw pencil, 10,6% draw exam paper, 6,6% draw book, 5,3% draw paper, 4% draw stick figures.

Table 6: The Environment Where Mathematicians is in Minds of Students

The Environment Where Mathematicians is	Female		Male		Total	
	f	%	f	%	f	%
Classroom/In front of blackboard	57	76.0	49	65.3	106	70.6
Work Room	12	16.0	7	9.3	19	12.6
Schoolyard	2	2.6	10	13.3	12	8.0
Canteen	2	2.6	5	6.6	7	4.6
University	0	0.0	2	2.6	2	1.3
Hell	1	1.3	0	0.0	1	0.6
Gallows	0	0.0	1	1.3	1	0.6
Home	0	0.0	1	1.3	1	0.6
Mathematics Highway	1	1.3	0	0.0	1	0.6

In analysis of students' drawings and the answers given to the question about the mathematicians environment, it is concluded that most of the students (70,6%) see mathematicians in class, 12,6% see in work

room, 8% see in schoolyard and 4,6% see in school canteen. When the environment mathematicians in is considered according to gender, female students (76%) mostly see them in classroom and 16% see them in work room. 65,3% of male students see them in classroom, 13,3% see them in schoolyard, 9,3% see them in work room and 6,6% see them in school canteen.

Table 7: Area of interest of Mathematicians in Mind of Students

Area of interest of Mathematicians	Female		Male		Total	
	f	%	f	%	f	%
Mathematics	22	29.3	27	36.0	49	32.6
Solving problems	4	5.3	9	12.0	13	8.6
Doing research	11	14.6	5	6.6	16	10.6
Proving something out	1	1.3	1	1.3	2	1.3
Tutoring	6	8.0	8	10.6	14	9.3
Doing Sports	5	6.6	7	9.3	12	8.0
Spending time with family	9	12.0	3	4.0	12	8.0
Spending time with students	6	8.0	1	1.3	7	4.6
Technology/Technological tools	1	1.3	3	4.0	4	2.6
Trade /Marketing	0	0.0	4	5.3	4	2.6
Agriculture/Farming	1	1.3	1	1.3	2	1.3
Reading book	4	5.3	2	2.6	6	4.0
Fishery	0	0.0	1	1.3	1	0.6
Cars	0	0.0	5	6.6	5	3.3
Music	5	6.6	1	1.3	6	4.0
Picture	1	1.3	0	0.0	1	0.6
Arranging trips	3	4.0	1	1.3	4	2.6
Cinema / Theatre	2	2.6	2	2.6	4	2.6
Having a pet	1	1.3	2	2.6	3	2.0
Personal care	1	1.3	1	1.3	2	1.3
Home design	1	1.3	0	0.0	1	0.6
Upsetting students	3	4.0	2	2.6	5	3.3
Everything except math	5	6.6	0	0.0	5	3.3

The findings shown in table 7 are found as a result of analysis of answers by students to open ended questions about area of interest of mathematicians. As it is seen in Table 7, 32,6%of students indicate that the interest are of mathematicians is mathematics, 10,6% indicate doing research, 9,3% indicate tutoring,8,6% indicate solving problems, 8% indicate doing sports, 8% indicate spending time with family and 4,6% indicate spending time with students. Besides these, 3,3% of students think that mathematicians are interested in anything except math and 3,3% of students think their interest area is upsetting students.

When the interest area of mathematicians is examined according to gender, when compared to male students, female students (14,6%) think that the interest area of mathematician is doing research, 12% thinks spending time with family, 8% think spending time with students and 6,6% think music. When compared to female students, male students (36%) think that the interest area of mathematicians is math, 12% think solving problems. Moreover, only male students (5,3%) think that the interest area of mathematicians is trade and 6,6% of them think it is cars. In the same way, only female students (6,6%) think that interest area of mathematicians is everything except math which is considered as a negative view.

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Table 8: Alternative Symbols in Drawings of Students

Alternative Symbols	Female		Male		Total	
	F	%	f	%	f	%
Whole numbers	8	10.6	4	5.3	12	8.0
Derivative symbol	8	10.6	3	4.0	11	7.3
Unknown (x,y,z)	9	12.0	1	1.3	10	6.6
Logarithm symbol	4	5.3	6	8.0	10	6.6
Trigonometrical symbols	3	4.0	6	8.0	9	6.0
Integral symbol	2	2.6	7	9.3	9	6.0
Sum symbol	4	5.3	3	4.0	7	4.6
Question mark	4	5.3	2	2.6	6	4.0
Root numbers	3	4.0	2	2.6	5	3.3
Exponential numbers	4	5.3	1	1.3	5	3.3
Equations	3	4.0	1	1.3	4	2.6
Inequalities	2	2.6	1	1.3	3	2.0
Rational numbers	1	1.3	1	1.3	2	1.3
Polynomial	1	1.3	1	1.3	2	1.3
Function	1	1.3	2	2.6	3	2.0
Multiplication	1	1.3	2	2.6	3	2.0
Addition	1	1.3	1	1.3	2	1.3
Complex numbers	1	1.3	2	2.6	3	2.0
Limit symbol	1	1.3	1	1.3	2	1.3
Pi number	1	1.3	0	0.0	1	0.6
Fibonacci sequence	1	1.3	0	0.0	1	0.6
Exclamation point	2	2.6	0	0.0	2	1.3
Apple	1	1.3	0	0.0	1	0.6

When Table 8 is considered, it is seen that the ratio of alternative symbols used by students in drawings are 8% whole numbers, 7,3% derivative symbol, 6,6% unknown (x,y,z), 6,6% logarithm symbol, 6% trigonometrical symbols and integral symbols. In drawings of female students, unknown (12%) is the mostly seen, 10,6% used whole numbers and 10,6% used derivative symbols, while in drawings of male students, integral symbol (9,3%) is the mostly seen, 8% used logarithm symbol and the same ratio used trigonometrical symbols.

Image Resources of Students towards Mathematicians

In order to determine the image resources of students towards mathematicians, the options students selected in the presented scale are analyzed and defined as it is seen in Table 9.

Table 9: Image Resources of Students towards Mathematicians

Image Resources	Female		Male		Total	
	f	%	f	%	f	%
Teachers	53	70.6	57	76.0	110	73.3
Biographies of Mathematicians	32	42.6	25	33.3	57	38.0
Science Magazines	25	33.3	21	28.0	46	30.6
Internet	19	25.3	17	22.6	36	24.0
Documentaries	9	12.0	14	18.6	23	15.3
Parents	12	16.0	9	12.0	21	14.0
Textbooks	9	12.0	12	16.0	21	14.0
Series	6	8.0	13	17.3	19	12.6
Newspapers	4	5.3	11	14.6	15	10.0
Cartoons	5	6.6	7	9.3	12	8.0
Animations	8	10.6	4	5.3	12	8.0
Friends	1	1.3	0	0.0	1	0.6

When Table 9 is considered, it is seen that 73,3% of students perceive their teachers, 38% perceive the biography of mathematicians, 30,6% perceive science magazines and 24% perceive internet as image resources of students towards mathematicians.

When the gender differences are considered, it is seen in the table that the 42,6% of female students see biography of mathematicians, 33,3% see science magazines, 10,6% see animations as image resources towards mathematicians, the ratio for the same themes in terms of male students is 33,3%, 28% and 5,3% respectively. The 76% of male students see teachers, 17,3% see series, 14,6% see newspapers as image resources towards mathematicians, the ratio for the same themes in terms of female students is 70,6%, 8% and 5,3% respectively.

Famous Mathematicians

The answers of open ended questions which take place in the scale in order to define the famous mathematicians from the viewpoint of students and the reasons of their choices are analyzed and given in Table 10 and 11.

Table 10: Famous Mathematicians According to Students

Famous Mathematicians	Female		Male		Total	
	f	%	f	%	f	%
Cahit Arf	24	32.0	35	46.6	59	39.3
Pythagoras	20	26.6	10	13.3	30	20.0
Harezmi	11	14.6	17	22.6	28	18.6
Einstein	5	6.6	15	20.0	20	13.3
Ali Kuscu	6	8.0	5	6.6	11	7.3
Omar Khayyam	3	4.0	4	5.3	7	4.6
Pascal	4	5.3	3	4.0	7	4.6
Farabi	5	6.6	1	1.3	6	4.0
Ali Nesin	3	4.0	3	4.0	6	4.0
İbn-i Sina	4	5.3	1	1.3	5	3.3
Euler	4	5.3	1	1.3	5	3.3
Thales	3	4.0	1	1.3	4	2.6
Euclid	3	4.0	0	0.0	3	2.0
Fibonacci	1	1.3	2	2.6	3	2.0
Mathematics Teacher	8	10.6	14	18.6	22	14.6
Himself	0	0.0	1	1.3	1	0.6
No idea	8	10.6	2	2.6	10	6.6

When Table 10 is considered, it is seen that 39,3% of students see Cahit Arf as the most famous mathematician, and he is followed by Pythagoras with 20% and Harezmi with 18,6%, mathematics teacher with 14,6%, Einstein with 13,3% and Ali Kuscu with 7,3%. Besides, it is remarkable that even if Einstein, Farabi and Ibn-i Sina are not mathematicians, students accept them as famous mathematicians. In addition to this, all the mathematicians in the table are male and the only one who is living is Ali Nesin are highly important points. Another significant point is that 14,6% of students see their mathematics teacher as a famous one and even if it is a less amount (0,6%), some students see themselves as a famous mathematician.

When the famous mathematicians analyzed according to gender, it is seen that when compared to male students, female students accept Pisagor (26,6%) as a famous mathematician and it is followed with Farabi with a ratio of 6,6% but 10,6% do not know any famous mathematicians. For male students, when compared to female ones, Cahit Arf (46,6%), Harezmi 22,6%, Einstein 20% and 18,6% see their mathematics teacher as the most famous mathematician.

Table 11: The Reasons Why Students Choose Famous Mathematicians

Reasons Why Famous Mathematicians are Chosen	Female		Male		Total	
	f	%	f	%	f	%
The contribution of their studies to field	25	33.3	27	36.0	52	34.6
The importance of their scientific researches	15	20.0	18	24.0	33	22.0
Their ingratiating mathematics	10	13.3	8	10.6	18	12.0
Their being hardworking	8	10.6	6	8.0	14	9.3
Their being Turk and Muslim	7	9.3	6	8.0	13	8.6
Their devotion themselves to mathematics	5	6.6	3	4.0	8	5.3
Their being determined	2	2.6	5	6.6	7	4.6

According to Table 11, 34,6% of students indicated that the reason why they had chosen famous mathematicians was their contribution to field, 22% say that the reason is the importance of their scientific researchs, 12% say their ingratiating mathematic, 9,3% say their being hardworking and 8,6% say their being Turk and Muslim. When the reasons why students choose, famous mathematicians are analyzed according to gender, it is seen that the ratio of answers by both female and male students is close to each other in Table 11.

DISCUSSION AND CONCLUSION

If the students are expected to see math as an attractive field and learn math like mathematician, their thoughts about math and mathematicians should be understood profoundly (Lim and Ernest, 1999; Rock and Shaw, 2000). Therefore, in this study, it is aimed to determine how high school students see mathematicians in reference to Picture in their minds.

When the drawings in which students picturize a typical mathematician image are analyzed to determine the image resources of students about mathematicians, it is seen that 146 (97,3%) students out of 150 students draw one of their mathematics teacher and 4 (2,6) of them draw a mathematics teacher. In similar studies, students are expected to draw a mathematician and it is seen that some of them draw their own mathematics teacher (Picker and Berry, 2000; Ucar et al., 2010; Aguilar et al., 2016).

The findings of this study which is towards the gender of mathematicians show similarities with literatüre. Students generally perceive the gender of mathematicians as male and the drawings which show mathematicians as female belong to female students (Picker and Berry, 2000; Piatek-Jimenez, 2008; Grevholm, 2010; Aguilar et al., 2016). Besides, the students perceive mathematicians as people at the age of 20-49 in general. Similarly, in the study by Rensaa (2006) the mathematicians are considered as middle age people.

Another finding of this study is that 29,3% of students perceive mathematician wearing suit, 7,3% perceive with teacher coat and 6% perceive as dressed sporty. The reason of this may be indicated as the drawings of most students reflect their math teachers. Similarly, in their study, Aguilar and his colleagues (2016) conclude that 33,3% of students perceive mathematicians with suit, 4,6% perceive them with laboratory coat. In addition to these, it is seen that 37,3% of students see them as well-groomed but 10% see them poorly groomed. On the contrary, Picker and Berry (2000) and Greyholm (2010) conclude in their studies that mathematicians are mostly poorly groomed and soap dodger. Besides, When the physical characteristics of mathematician examined according to gender, when compared to male students, female students mostly (41,3%) see mathematicians well groomed, 10,6% see them dressed sporty and 18,6% see them cheerful. When compared to female students, male students (14,6%) see mathematicians as poorly groomed in a high level, 22,6% see them bearded, 16% see them mustached, 24,3% see them fat and bellied. In the light of this finding, it can be said that female students are consonant with their social roles.

In current study, it is seen that 13,3% of students see mathematicians clever, 10,6% see them hardworking, 18,6% see them entertaining/humorous, 16,6% see them helpful and 10% see them insightful/tolerant on the other hand 10% see them merciless, 8% see them angry and 8% see them boring. In addition to these, 8,6% see

mathematicians asocial and 4% see them social, 4,6% see them offensive and 3,3% see them threatening with score. When literature is reviewed, it is seen that mathematicians are seen as clever, serious and asocial people by students in the study by Ucar and his colleagues (2010). In the study by Rensaa (2006) mathematicians are seen 41% asocial, 12% social, 61% boring and 3% entertaining/humorous. In the study by Picker and Berry (2000), mathematicians are at high incidence of oppressive and threatening. When the findings of this study are examined it might be concluded that the thought of students towards mathematicians are more positive.

The students in this study, generally draw mathematician in classroom, work room and around school. When the materials used by mathematicians in drawings of students, it is seen that students draw pencil, book, exam papers, pocketbook and bag, and also only 2 of the students draw computer. In parallel to these findings, ın the study by Aguilar and his colleagues (2016), students perceive mathematicians in classroom or in Office and they use pencil, book, blackboard, desk and eraser. Similarly, only one student draws a computer. From here, it can be concluded that mathematic teachers do not use materials and technology in classes.

In his study, Rensaa (2006) shows the reason of image sources towards mathematicians as society, family, school life and media. In a similar way, Aguilar and his colleagues (2016) determine that school environment in other words teachers and text books as the image resource towards mathematicians. In this study, students mostly see their image resources towards mathematicians as their math teachers, and this is followed by biography of mathematicians, science magazines, internet, documentaries and textbooks. Based on this finding, it can be said that mathematic teachers and the students' experience with mathematics has a big role in positive or negative beliefs of students about mathematicians. For that reason, teachers should be aware that they are effective in belief of students and should act accordingly. For Picker and Berry (2000) teacher should make students feel that mathematics is not a magic, they also feel slog away from time to time an even the most famous mathematicians may not be good at some branches of it. Also, the institutions raising teachers about this topic have a big role. Teacher candidates should be informed about the beliefs of students towards mathematics teachers and mathematicians and they should be given learning activities that will be effective in changing these beliefs from negative to positive (Ucar et. al., 2010). In addition to these, in the light of this finding, it can be said that in order to develop a positive image of students towards mathematicians, media, internet and textbooks should give coverage to the studies and life story of mathematicians.

Another finding of this study is that Cahit Arf is the most famous mathematician for students and he is followed by Pisagor, Harezmi, their mathematics teacher, Einstein and Ali Kuscu. It is thought that students mostly preferred Cahit Arf as his photo is on the back side of 10 TL. Apart from this, it is seen that even if Einstein, Farabi and İbn-i Sina are not mathematicians, they are mostly preferred ones. In addition to this, the mathematicians in the given table are all male and only Ali Nesin is alive. The reasons of this situation are that media and textbooks generally do not use female mathematician figures, mathematics is shown as occupation of male and modern day mathematicians are not mentioned. For that reason, the studies of mathematicians which have different gender and age levels should be promoted through media, documentaries and textbooks. Students should be taught that there is no gender or age limit to become a mathematician and everyone who wishes can become a mathematician. Apart from this, student should get concrete experience through creating meeting opportunities with mathematicians at their environment or in school environment.

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REFERENCES

Aguilar, M.S., Rosas, A., Zavaleta, J.G.M., & Romo-Vazquez, A. (2016). Exploring high-achieving students' images of mathematicians. *International Journal of Science and Mathematics Education, 14*, 527–548.

Bodzin, A., & Gehringer, M. (2001). Breaking science stereotypes. *Science and Children, 39*(1), 36-41.

Cermik, H. (2013). A scientist created in the picture that pre-service teachers have in their minds. *Pamukkale University Journal of Education*, *33*, 139-153.

Chambers, D.W. (1983). Stereotypic images of the scientist: The draw a scientist test. *Science Education, 67*(2), 255-265.

Erkorkmaz, Z. (2009). *İlköğretim I. akdeme öğrencilerinin bilim insanına ilişkin görüşlerinin belirlenmesi*. Yayınlanmamış Yuksek Lisans Tezi, Süleyman Demirel Üniversitesi, Fen Bilimleri Enstitüsü, Isparta.

Finson, K. D., Riggs, I.M., & Jesunatahadas, J. (1999). The relationship of science teaching self efficancy and outcome expectancy to the Draw-A-Science-Teacher Teaching Checklist. *Paper Presented at the Annual International Conference of The Association of Educators of Teachers of Science*, Austin, TX.

Finson, K. D. (2002). Drawing a scientist: What we do and do not know after fifty years of drawings. *School Science and Mathematics. 102*(7), 335–345.

Gonsoulin, W.B. (2001). *How do middle school students depict science and scientist.* Mississippi State University, Curriculum and Instruction, Doctoral Thesis, UMI Number: 3005589.

Grevholm, B. (2010). Norwegian upper secondary school students' views of mathematics and images of mathematicians. In K. Kislenko (Ed.), Current state of research on mathematical beliefs XVI. Proceedings of the MAVI-16 Conference (pp. 120–136). Tallin, Estonia: Institute of Mathematics and Natural Sciences, Tallin University.

Hammrich, P. (1997). Yes daughter you can: Empowering parents is the first step toward improving females' achievement in science. *Science and Children, 34*(4), 21-24.

Kavak, G. (2008). *Öğrencilerin bilime ve bilim insanına yonelik tutumlarını ve imajlarını etkileyen faktörler.* Yayınlanmamış Yuksek Lisans Tezi, Selcuk Universitesi, Sosyal Bilimler Enstitusu, Konya.

Kaya, O.N., Doğan, A., & Ocal, E. (2008). Turkish elementary school students' images of scientists. *Eurasian Journal of Educational Research, 32*, 83-100.

Korkmaz, H., & Kavak, G. (2010). Primary school students' images of science and scientists. *Elementary Education Online, 9*(3), 1055-1079.

Lim C.S., & Ernest, P. (1999). Public images of Mathematics. *Philosophy of Mathematics Education Journal, 11*, 43-55.

Medina-Jerez, W., Middleton, K.V., & Orihuela-Rabaza, W. (2011). Using the DAST-C to explore Colombian and Bolivian students' images of scientists. *International Journal of Science and Mathematics Education, 9*(3), 657–690.

Miles, M.B., & Huberman, A.M. (1994). *Qualitative data analysis.* Thousand Oaks, CA: Sage.

Narayan, R., Park, S., Peker, D., & Suh, J. (2013). Students' images of scientists and doing science: an international comparison study. *Eurasia Journal of Mathematics, Science & Technology Education, 9*(2), 115–129.

Piatek-Jimenez, K. (2008). Images of mathematicians: A new perspective on the shortage of women in mathematical careers. *ZDM, 40*(4), 633–646.

Picker, S.H., & Berry, J.S. (2000). Investigating pupils' images of mathematicians. *Educational Studies in Mathematics, 43*(1), 65–94.

Rensaa, R. J. (2006). The image of a mathematician. *Philosophy of Mathematics Education Journal, 19*, 1–18.

Rock, D., & Shaw, J.M. (2000). Exploring children's thinking about mathematicians and their work. *Teaching Children Mathematics, 6*(9), 550-555.

Smith, W., & Erb, T. (1986). Effect of women science career role models on early adolescents. *Journal of Research in Science Teaching, 23*(8), 667-676.

Song, J., & Kim, K.S. (1999). How Korean students see scientists: the image of the scientist. *International Journal of Science Education, 21*(9), 957–977.

Turkmen, H. (2008). Turkish primary students' perceptions about scientists and what factors affecting the image of the scientists. *Eurasia Journal of Mathematics Science and Technology Education, 4*(1), 55-61.

Uçar, Z., Pişkin, M., Akkaş E.N., & Taşçı, D. (2010). Elementary students' beliefs about mathematics, mathematics' teachers and mathematicians. *Education and Science, 35*, 131-144.

Yalcın-Aggül, F. (2012*). Investigation of prospective teachers' image of scientist with respect to some variables. Elementary Education Online, 11*(3), 611-628,

Yıldırım, A., & Simsek, H., (2006). *Sosyal Bilimlerde Nitel Araştırma Yontemleri*. Ankara: Seckin.

Wyer, M. (2003). Intending to stay: Images of scientists, attitudes toward women, and gender as influences on persistence among science and engineering majors. *Journal of Women and Minorities in Science and Engineering, 9*(1), 1–16.