Turkish elementary and secondary students' views about science and scientist

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Contents

Abstract

The aim of this study was to determine elementary and secondary students' views concerning science and scientists. Data gathered from Draw-a-Scientist Test (DAST) and essays written by students were used to analyze their views. The study involved 359 students in grades 5 through 11. The results indicate that student's perceived scientists as to be males who are young age, do their work indoors, smile while working, and believe that they have dedicated their lives to humanity. Further, students have been building up more positive images of scientists through upper grades. Secondary school students have less stereotypical images of scientists than the elementary school students.

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Introduction

To create a scientifically literate society, current science education reform in Turkey focusing on students who are expected to understand how scientific knowledge is generated, increase inquiry and problem solving skills and to understand the interaction among science, technology, and society and its effect on the work of scientist. *Science for All Americans* (American Association for the Advancement of Science (AAAS), 1990) makes cultural arguments for gaining scientific literacy and emphasizes how a scientific explanation is different in varying cultures or a different time can contribute to the present scientific understanding. Therefore, it is crucial for students to understand science and technology as human activities that have interacted through time, as part of our culture, and affected by the varying cultures**.**

Students come to classrooms with their prior knowledge about science and scientists. This existing knowledge is mostly stereotypical and influenced by media, their parents, and the public (Chambers, 1983). Their cultural values also influenced their lives. Studies have shown that girls and boys have different interests and attitudes about studying science and hold different perceptions of scientists and science careers (Jones et al, 2000).

Beginning as early as elementary school, boys have typically possessed more interest in studying science than girls. By middle school, girls' attitudes toward science tend to decline and this situation continues through high school. Boys mostly prefer to read science articles, watch science television shows, and complete science projects. Males have more opportunities to conduct experiments, carry out demonstrations, and manipulate equipment (Jones et al, 2000; Losh, Wilke & Pop, 2008; Miller, Blessing, & Schwartz, 2006).

Draw-A-Scientist Test developed from Chambers (1983) as an alternative of written instruments to help children who like to draw more than they do writing. It aims to assess student conceptual images. In 1995, Finson, Beaver, and Cramond developed the Draw-A-Scientist Checklist (DAST-C) to assess drawings.

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In the previous studies, the students' perceptions of scientists were illustrated as male, elderly-aged, having glasses, some facial hair, wearing a lab coat, working indoors surrounded by equipment, and doing dangerous things. Indicator symbols of research are described as test tubes, various types of flasks, beakers, Petri dishes, burners (Symington and Spurling, 1990; Chambers, 1983; Mead and Metraux, 1957; Scherz and Oron, 2006). However, Turkmen (2008) argued that smiling scientists and indicators of technology increased in Turkish students' images of science and scientists.

This study is based on an analysis of Draw-a-Scientist Test and essays written by elementary and secondary students in Turkey. The aim is to find out when students are asked to draw a scientist what comes to their minds and how these ideas are expressed in images and essays.

Methods

Participants: The sample consists of 359 students from 5th to 11th grades consisting of 235 boys and 124 girls from three different primary and secondary (General High) schools located in the same city. In this study drawings were obtained from a convenience sample of science students, including 5th grade (n=50), 6th grade (n=82), 7th grade (n=89), 8th grade (n=51), 9th grade (n=41), 10th grade (n=29), and 11th grade (n=17).

Data collection: The Draw-a-Scientist Test (Chambers, 1983) was used to collect data. Students from grades five to eleven were supplied blank sheet of paper and asked to "Draw a drawing which tells what you know about scientist and their work" (Symington and Spurling, 1990). To increase the effectiveness of the data obtained from DAST, students were encourage to add sentences, annotating about what scientists do (Rennie and Jarvins, 1995) on their drawings.

Data analysis: This study is based on qualitative data. The Finson, Beaver and Cramond (1995) protocol was used to analyze students' drawings. In this protocol, each drawing was rated for specific stereotypic images and additional information obtained from the students' narratives using The Draw-a-Scientist Checklist (DAST-C) (Finson et al., 1995). Seven types of indicators were chosen to describe stereotypes of scientists proposed by Finson et al. (1995), including (1) lab coat, (2) eye glasses, (3) facial growth of hair, (4) symbols of research, (5) symbols of knowledge, (6) technology and (7) relevant captions. In addition, seven alternative

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indicators were added to analyze the drawings. These are male gender, indication of danger, presence of light bulbs, mythic stereotypes, indication of secrecy, and scientists doing work indoors, and being middle aged or elderly persons.

The analysis of the student essays about science and scientist were categorized as (1) "type of explanation" includes plain assay, poem, and word puzzle; (2) "what scientists do" includes help to society and humanity, produced and invented new things, remedy for illnesses and problems; (3) "scientist who" have large brains, objective, curious, open to criticism, thinker, independent, smart, work hard, patient,

Results

The stereotypical images of scientists wearing glasses and a lab coat, having facial hairs and doing dangerous and secret things decreased compared to those reported in previous studies. In addition, when students get older their stereotypical images of scientists were decreased. They now have more positive image of scientist.

It is interesting to find opposite ideas to most former studies. The results of this study show that student images of scientists are become more positive. Because the drawings include very low percentages of wearing lab coats, indications of secrecy, middle age or elderly scientists, angry or crazy expressions (Table 1).

However, when the question becomes standard images of symbols; the overall results of grades 5 through 11 showed that symbols of doing research (83.4%), symbol of knowledge (16.2), male gender (57.8%), working indoors (23%) and stereotypic images of scientists, including wearing eyeglasses (20%) remain negative. In addition, results show that the negative views are higher among elementary school students than secondary school students. It means that when students get older and have more contact with science and scientist and their views become more positive (Table 1).

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Table 1: Stereotypical Image of Scientist by Percentage

Trait	Elementary School (Grade 5 to 8)			Secondary School (Grade 9 to 11)		
	Female (N= 96)	Male (N=176)	**Overall (N=272)**	Female (N=28)	Male (N=59)	**Overall (N=87)**
Lab Coat	3.3%	2.6%	5.9%	3.4%	-	3.4%
Eyeglasses	8.1%	11.7%	19.8%	6.9%	9.1%	16.0%
Facial growth of hair	1.8%	8.1%	9.9%	1.1%	8%	9.1%
Symbols of research	28.6%	55.5%	84.1%	26.4%	35.6%	62.0%
Symbols of knowledge	9.9%	7%	16.9%	5.7%	4.6%	10.3%
Technology	6.3%	16.9%	23.1%	6.9%	12.6%	19.5%
Relevant captions	2.6%	5.1%	7.7%	1.1%	5.7%	6.8%
Male gender	16.2%	45.9%	62.1%	9.2%	21.8	31.0%
Indication of danger	0.7%	5.5%	6.2%	-	2.2%	2.2%
Presence of light bulb	3.3%	4%	7.3%	3.4%	6.9%	10.3%
Mythic stereotypes	1.1%	6.6%	7.7%	-	3.4%	3.4%
Indication of secrecy	-	0.4%	0.4%	-	1.1%	1.1%
Scientists doing work indoors	6.6%	13.6%	20.2%	14.9%	11.5%	26.4%
Middle age or elderly scientist	0.4%	0.7%	1.1%	-	-	-
Angry or crazy expression	0.4%	4%	4.4%	-	1.1%	1.1%

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Figure 1: 5th Grade Female Students Drawing of Scientist

Figure 2: 5th Grade Male Student's Drawing of Scientist

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In essays, student positive perceptions of science and scientists were more evident in secondary level. Students explained that science is responsible for progress, improving the health and quality of life, and they work very hard, are patient, open minded, open to criticism, trustworthy, and curious (Table 2).

Table 2: Student Perceptions of Scientists from Students' Essays

	Elementary School (N=272)		Secondary School (N=87)	
Type of essays	%	Example	%	Example
Plain essays	9.1	Actually, I have never seen scientist before but I want to see one. In my dream, scientists have white hair and wear glasses with angry expressions work with different tools, dedicated his (her) life to science; work in a place where nobody can disturb him. When I heard the word scientist, I was frustrated. After awhile I was used to it. (6th grade)	40.2	Our country has not got many scientist but foreign countries have enough. When the countries have enough scientists, they become more powerful and developed. But countries have few scientists that cannot read the develop era (9th grade female)
Poems	8	Man scientist Woman scientist Both are the same actually Beyond the miracles Create miracles Work for people Develop creative things Don't do anything harmful (5th grade)	-	
Word puzzle	4	Have intelligence, have brain, the mind has Do beneficial things Guess what is it? (7th Grade)	-	

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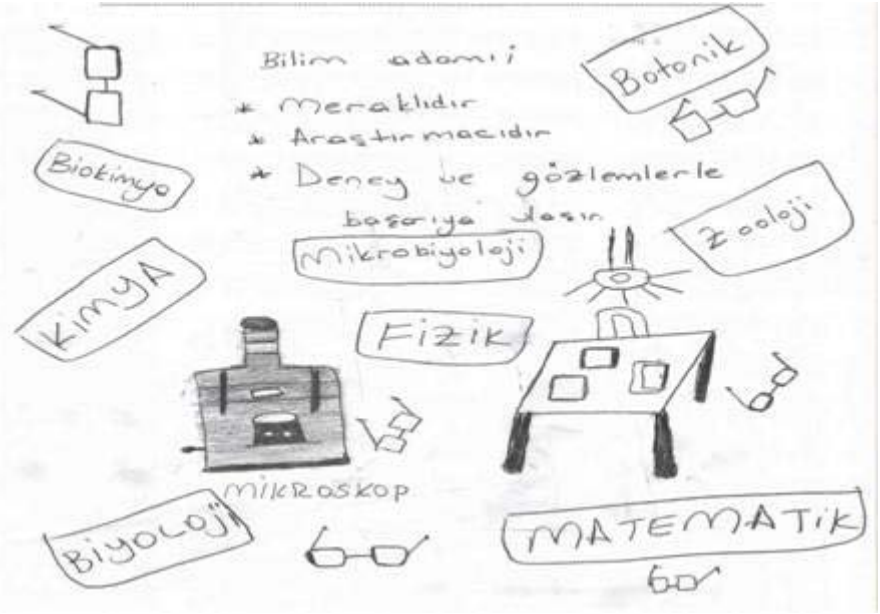
Table 3: Explanation of Science and Scientists from Students' Essays

What scientist do	Elementary School (Grade 5 to 8) %	Secondary School (Grade 9 to 11) %
Helpful to society and humanity	21.7	46
Produced and invented things	26.8	24
Scientist who		
have large brains	0.7	-
objective	-	18.3
curious	1.8	5.7
open to criticism	-	5.7
thinker	1.5	6.9
independent	1.1	8
smart	8.4	10.3
work hard	2.6	6.9
patient	1.8	3.4
can make mistakes	-	1.1
know everything	1.5	6.9

Figure: 10th Grade Female Student's Drawing



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Students preferred to use different types of essays including plain writing, poems, and riddles. The analysis of essays showed secondary school students preferred to use both writing and the drawings (57.5%) than the elementary school students (32%). In addition, none of the secondary school students preferred to use any poems or word puzzles while elementary school students preferred to use of poems (8%) and word puzzles (4%) (see Table 2).

In Table 3, Secondary school students defined scientists in more positive ways as being objective (18.3%), curious (5.7), open to criticism (5.7), a thinker (6.9), independent (8%), smart (10.3%), work hard (6.9), patient (3.4%), can make mistakes (1.1%) than do elementary school students. Forty-six percent of secondary school students indicated that scientist's job is being helpful to society and humanity as well science being responsible for curing diseases, improving quality of life compared to 21.7% of elementary school students.

Interestingly, 4% of elementary school students indicated that they have no exposure to scientists practicing normal science. Students only named ten (10) scientists in drawings and essays mostly by elementary students, including Newton, Aristo, Einstein, Edison, Lamark, Darwin, Arshimed, Magellan, Graham Bell, and Ibni Sina. None of these scientists were female. This is thought to be just because the science textbooks mainly include male scientist figures and their work.

Girls and boys have different views about science and scientists in all grades. Only boys drew monster figures of scientists especially the elementary students (8-students) compared to secondary students (2-students). Regardless of the grade, only girls drew women scientists. Also, girls tend to draw both genders in their drawings more so than boys.

Conclusions and implications

In this study, images of scientist were found conflicted with previous studies. Previous studies argued that majority of students in all age lines drew elderly-aged male scientists wearing white lab coats and glasses with facial hair and doing research indoors with chemicals (Chambers, 1983; Symington and Spurling, 1990; Finson, 2002; Turkmen, 2008; Jones and Bangert, 2006). However, the results showed that students perceived scientist as being males who are a younger age, do their work indoors, smiling while working, and dedicated to their life for humanity. The image of scientists having facial growth of hair, wearing lab coats, and doing

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dangerous things, storybook stereotype, relevant captions and presence of light bulb were less presented in the drawings of secondary level students. In addition, compared to Speering and Rennie (1996) findings, stereotypical images of science and scientists were found to very less in secondary school students compared to elementary school students. It would be because of when students get older the change of being exposed to many different models of science that involve scientist practicing normal science help them to have more accurate image of science and scientists.

In this study, historically and culturally image of scientists, scientists with large brain, elderly or middle age scientist and indication of secrecy were merely existed. This was opposite to former studies where the scientist has bald head is not existed in the drawings.

Like as Turkmen (2008), this study showed that happy and smile expressions of scientist while doing their research (22%) was increased compared to angry, crazy expressions (4.7%). The ethnic representation is not exist because all Turks are Caucasian, subjects of this study not see black, Hispanic or Asian people around them very often.

The author argues that students' stereotype image of scientists is mostly coming from popular culture. According to Gardner (1980) students' mental schema is affected by cultural models to which students are exposed. In the Turkish language the word "scientist" means "bilim adamı". In translation from Turkish to English "bilim" means "science" and "adam" means "man". So scientist in Turkish means "science man" It may result in stereotypical image of male scientist in the drawings of Turkish students. For this reason, in Turkey, science teachers should try to use "bilim insanı" meaning "science person" while teaching science.

Teachers need to teach differently to change these stereotypes perceptions of science and scientists. As well students should be exposed to positive images of science and scientists (Speering & Rennie, 1996). Because most of the students have no exposure to scientists practicing normal science in different settings during early ages, teachers should expose students to many different models of science and scientists while practicing normal science beginning of kindergarten through high school.

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