

TURKISH STUDENTS' IMAGES OF SCIENTISTS

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Introduction

During the 20th century, while the practice of science was studied and clarified, it has acquired a new status in society. Parallel to this development, the image of scientists has changed and become more stable, with standardised characteristics. Several variables have affected the standardisation process, but the influence of science in schools and the role of science teachers must be considered paramount. The science teacher is in a unique position to influence students' impressions of science teaching, science, and scientists all at once. These impressions may affect the students' values and attitudes towards science and shape their images of scientists. As Finson, Beaver, and Cramond (1995) point out, researchers do not know precisely what effect stereotypical images of scientists have on children's perceptions of science, but the indications from research are that negative stereotypical images translate into negative perceptions. This means that when stereotypical images have negative connotations for an individual, they will prevent him/her from developing positive attitudes about science and the various objects and activities associated with science. It is known that affective variables such as attitudes have a strong influence on learning, career plans, and leisure time activities as cognitive variables. Attitudes are learned from experiences both actively or vicariously; students are not born with attitudes about learning science or about scientists. The classroom is one of the major influences on attitude formation and change; thus, science teachers have opportunities to influence multitudes of children and teenagers' attitudes towards science and scientists.

The basic aim of science education is to develop scientifically and technologically literate citizens after approximately 12 years of schooling. One of the characteristics of this literate person is to appreciate science and technology for the intellectual stimulus they provide and to have a positive attitude towards the science, technology, and scientists.



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Abstract. *This study analyses the drawings of scientists done by Turkish students, primarily to learn how the students have represented scientists and to find out the stereotypical images that they use. The drawings are compared with the results of a similar study conducted twelve years earlier by the same author. Gender characteristics and differences are a focus of interest. The Draw-a-Scientist Test (DAST) was used to record and analyse the images. The sample for the study consisted of 520 students from various grade levels. Their drawings are discussed in terms of three themes: the general use of standard indicators, gender differences in stereotypical images, and implications of the results for teaching and learning science.*

Key words: *Draw-A-Scientist Test (DAST), images of scientists, scientific literacy, values in science education.*

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In the course of their education, students form images of scientists and scientists at work. These images have become an interesting topic for science education communities (Schibeci, 2006). Consequently, a considerable amount of research has investigated students' images and related attitudes towards science (Krajkovich & Smith 1982; Parker & Rennie, 1986; Koballa, 1988; Flick, 1990; Finson, Beaver & Cramond, 1995; Huber & Burton 1995; Talsma, 1997; Jones, Howe & Rua, 2000; Buck, Leslie-Pelecky & Kirby, 2002; Fung, 2002; Quita, 2003; Buldu, 2006; Thomas, Henley & Snell, 2006; Miller, Blessing & Schwartz, 2006; Talsma, 2007; Losh, Wilke & Pop, 2008; Türkmen, 2008; Lee, 2010). The study conducted by Mead & Metraux in 1957, which analysed American high-school students' images of scientists, was the earliest example of this type of research. They collected qualitative data from approximately 35,000 high school students by using essay-type questions. Acknowledging the results of that study, Chambers (1983) developed the Draw-a-Scientist Test (DAST) as a way of measuring the images of scientists. Since then, as Rosenthal (1993) mentions, drawings have become one of the most important research instruments used to study students' concepts of scientists at work. Schibeci and Sorensen (1983), who used the test in two schools in Western Australia, claimed that DAST is a quick, reliable, and useful method of assessing students' images of scientists.

Chambers' (1983) looked at children's earliest drawings and described how variables such as socio-economic status, intelligence, and gender influenced their images of scientists. He administered the DAST to 4807 children in K-5 classes. He found that only female students drew female scientists and noted that stereotypical images of scientists appeared at the second grade level and that the number of indicators of stereotypical images tended to increase at successive grade levels. Newton and Newton (1992) reported that students' stereotypical images appeared as early as six years of age, and Rahm and Charbonneau (1997) discovered that stereotypical images tend to remain stable throughout high school and university.

Research Focus

The present study examines Turkish students' images of scientists and compares recently collected images with those drawn by a similar sample of students for an earlier study conducted by the author (Toğrol 2000). That earlier study was a cross-sectional analysis of stereotypical images according to grade level. DAST was the instrument of choice, and analysis of the drawings of 443 students showed that their images of scientists were similar to those found in previous western studies. One of the reasons for comparing recent images with earlier images is that after the year 2000 the Turkish national science curriculum was changed radically. By the year 2005, as a result of extensive curriculum reform at all levels from kindergarten to 8th grade, a constructivist approach to science teaching replaced the traditional teacher-centred approach of earlier years. In the process of revision, the emphasis shifted from teaching science and learning science to doing science. Scientific literacy for all students became the goal of the science curriculum. The Ministry of Education set standards for textbooks and only text books that met the standards were selected for use in state-supported schools. In the year 2011-2012, a population of students progressing through the new curriculum reached the same age as the students tested in the 2000 study. Thus, a comparison of the images drawn by the two student groups may yield some information about the influence of the new curriculum and the new textbooks. Because it is a centralised educational system and thus it effects an important percent of the student population throughout country, any research that serves to enlighten the impact of change is important.

Methodology of Research

This study was designed to investigate the images of Turkish students related to the scientists. In this respect it is a descriptive study. For the purpose of the investigation Draw-a-Scientist Test (DAST) was administered in the classroom settings by the regular teachers as well as the researcher. Analysis and interpretation of student drawings were the basic data for this investigation.



Sample of Research

The sample for the study consists of 272 female and 248 male students in grades 5-8 (see Table 1). Totally 520 students from three state supported schools were the participants. They were approximately ten to thirteen years old. The sample for the 2000 study was taken from the same grades, as well as grades 9 and 11, and a total of 443 students participated.

Table 1. Grade, and gender distribution of the sample.

Grade	n
5	208
6	52
7	105
8	155
Gender	
Female	272
Male	248
N	520

Instrument and Analysis of Drawings

The instrument used in the study is the Draw-a-Scientist Test (DAST) developed by Chambers (1983). It is a qualitative projective instrument with an open-ended response format. Only instruction given to students taking the test is *draw a picture of a scientist*, and they are given a blank sheet of paper for the purpose. Subsequently, their drawings are assessed according to certain characteristics. It is a quick and practical instrument for assessing global images of scientists (Schibeci and Sorensen, 1983). DAST is not merely an extension of the Draw-a-Man or Draw-a-Person tests which have been used to reveal the drawer's intelligence, self-image or certain emotional states or conflicts (Chambers, 1983).

Author's 2000 study is the earliest study which DAST was used for clarifying Turkish students' images of scientists. In that study a checklist was prepared for the analysis of drawings. To prepare the checklist, the drawings of 197 students in grades 6, 7, and 8 were analysed, and the indicators portrayed in those drawings were recorded by two different scorers. The results of that pilot study revealed that several characteristics of the images of scientists coincided with characteristics reported by other researchers in earlier studies (Mead & Metraux, 1957; Chambers 1983; Schibeci & Sorensen, 1983; Finson, Beaver & Cramond, 1995). These indicators included such features as eye glasses, lab coat, facial hair, and baldness; qualities of appearance such as elderly, unkempt, and confused; the use of symbols and/or captions to indicate abstractions such as research and knowledge; if a setting was indicated it was usually indoors. Some of the characteristics found in previous studies, however, were not found in the pilot study (e.g., Caucasian, secrecy, and some mythical stereotypes) and thus were not included in the checklist.

To test for, intra-scorer (intra-judge), inter-scorer (inter-judge) reliability, following studies were conducted. The author scored and re-scored 45 of the drawings at different times and found the correlation coefficient of these two sets of scores to be 0.92, $p < 0.001$. Also, an inexperienced second scorer scored 68 drawings that were scored previously by the author, and the correlation coefficient for these two sets of scores was 0.71, $p < 0.001$ (Toğrol, 2000). These results indicate fairly high inter-scorer and intra-scorer reliabilities, similar to the reliability studies found in earlier research conducted by Schibeci and Sorensen (1983).

Above mentioned checklist of indicators was used in the current study. Thus the administration of the instrument and the analysis of drawings in both studies were similar.



Results of Research

In the present study, as in the earlier study, every drawing was transcribed and the frequency of each indicator recorded. The frequency distribution of standard indicators is given in Table 2. The stereotypical image of scientists may be summarised as follows: *a smiling bald man in a lab coat, with glasses and facial hair, who works indoors alone*. The indicators contributing to this description appeared in the drawings of at least 15% of the sample (see Figure 1 and Figure 2).

Among the 520 images drawn by students in grades 5-8, the majority depicted male scientists. Although 53% of the participating students were female, only 13% of the drawings were of female scientists.



Figure 1: Smiling scientist.



Figure 2: Happy scientist.

Nowadays, scientists usually work in groups. A team of research scientists may come from different countries and include both genders and all ages. Out of 520 drawings, only 8 showed a scientist working in some kind of group; all the others showed a man/woman working alone. To understand the work done by scientists, student should learn that much of it depends on shared information and focused interaction with peers.

Table 2. Analysis of drawings-frequency of indicators.

Indicators	N=520 Frequency	%
Crazy Hair	118	23
Bald	105	20
Facial Hair	83	16
Being Elder	23	04
Wearing Glasses	127	24



Indicators	N=520 Frequency	%
Wearing Lab Coat	78	15
Technology	30	6
Smiling	237	46
Crazy Mood	63	12
Being Alone	501	96
Working Indoors	124	24
Unkempt Appearance	70	13

The results of the two studies will be discussed and compared in terms of three themes; first, the use of standard indicators; second, gender differences in stereotypical images; third, implications for science teaching and learning. The standard indicators shown in Table 3 show some interesting differences between the drawings of 2000 and 2012. In 2012, 46% of the scientists are smiling, whereas *smiling* in 2000 was not even a category. The frequency of unkempt scientists, scientists wearing lab coats, and scientists wearing glasses decreased in 2012, and today's scientists have become younger.

Table 3. Comparison of frequencies of indicators.

Indicators	N=520 Frequency 2012	% 2012	N=443 Frequency 2000	% 2000
Bald	105	20	130	29
Facial Hair	83	16	138	31
Being Elder	23	04	38	9
Wearing Glasses	127	24	204	46
Wearing Lab Coat	78	15	106	24
Technology	30	06	46	10
Smiling	237	46	*	*
Crazy Mood	63	12	27	6
Being Alone	501	96	439	99
Working Indoor	124	24	132	30
Unkempt Appearance	70	13	59	30

* no category

As it is shown in Table 4, 68% of students in the 2012 sample drew a male scientist. A further breakdown of the data shows that 16% of the drawings do not indicate a gender, 88 of these are *stick* figures, some of which may have been imagined as male, but none of the 88 is included in the 68% identified as male. Only 13% of students in the sample ($n = 68$) drew distinctly female scientists. Of these 68 drawings, 66 were drawn by female students. Comparison of the data from 2000 with the data from 2012, as shown in Table 4, reveals that the predominant male image has persisted for the past 12 years.





Figure 3: Woman scientist working with time machine.

Table 4. Comparison of frequencies of gender.

Indicators	N=520 Frequency 2012	% 2012	N=443 Frequency 2000	% 2000
Male	356	68	321	73
Female	68	13	56	13
Both Male and Female	8	1	5	1

Discussion

Chambers in 1983, reported that only 28 out of 4807 childrens' drawings of scientists depicted females, and all 28 were drawn by girls. Similarly, several other research studies including Turkish studies (Mason, Kahle & Gardner 1991; Huber & Burton 1995, Buldu 2006; Turkmen 2008) detected a male predominance parallel to the findings clarified in the current study.

So the results of the present study as well as the studies in the related literature indicate that both females and males do not find that being a female scientist is a stereotypical image in the society. A student's image of a scientist influences his or her present and future life; an exclusively male image is likely to discourage a girl from starting a career in science.

Students' attitudes towards science have been researched extensively, and some such research studies report that males are more likely to be interested in science than females. Some report that females, if interested in science at all, are more likely to be interested in the biological sciences than the physical sciences, the image of which is strongly male. The primary school experience of girls may have an important influence on their attitude towards science at the secondary and tertiary levels. Children acquire an interest in science at an earlier age than most areas of study, and childrens' interest in science is established well before secondary school age. Girls and boys enter science classrooms with gender-related attitudes (Reid & Stephens, 1985; Jones & Wheatly, 1988; Mason, Kahle & Gardner; 1991). Boys react positively to careers in science, whereas girls tend to reject science-related careers for themselves and for their future husbands (Mead and Metraux 1957; Lawrenz and Welch, 1983; Jones and Wheatly,

1988). However, research does suggest that girls are more likely to pursue a scientific career when they receive positive messages from parents, teachers, counsellors, and peers, when they are exposed to positive role models, and when they expect to succeed (Jones & Wheatly, 1988; Huber & Burton, 1995). For example, according to Talton, and Simpson (1986), family variables predicted between 13-39% of the variance in attitudes toward science, and classroom environment variables accounted for 46-73%. Of course, many teachers and parents, whose attitudes were formed when they were children, - who are and very important figures for child's attitude formation- have become accustomed to patterns of gender differentiation, which they then take to be normal.

For all the reasons mentioned above, the lack of a strong female presence in science courses as takes place in the related literature is not surprising. In Turkey, science courses are required for all students in grades 4-12. In grade 9, a general science course is a required course of all students attending high school. So in a way this requirement may be used as an opportunity for effecting female students' attitudes towards science in a positive way. In grades 10, 11, and 12, students may choose different programs, and students who are science majors are required to have physics, chemistry, and biology courses.

Students are not influenced only by their personal images they hold for scientists, but also by the style of science course they experience and by cultural impressions (Farland-Smith, 2009). For example Chambers (1983), investigated the Anglophone/Francophone culture on the formation of the standard image of scientists. Rubin and Cohen (2003), conducted their study in order to analyse the images of scientists and science among Hebrew and Arabic speaking teacher candidates in Israel. In both of the studies, effects of different cultures clarified. In the same vein a peculiarity of the Turkish language may also affect Turkish students' images of scientists. The word for scientist, actually a phrase, is not gender free. *Bilim adamı* means scientist, but literally translated into English it means *science man*. When administering the DAST to students in 2000 and 2012, the author used a gender neutral phrase, *bilim insanı*, which replaces *science man* with *science person*.

The more recent images of scientists seem more positive and more realistic. Parallel with the conclusion of Turkmen (2008), who has conducted a study with 287 Turkish fifth graders. In the current study image of serious and angry scientist (see Figure 4) is disappearing, to be replaced by a younger and smiling scientist. In that respect text books, may help students to revise their stereotyped images and develop a better understanding of the normal and productive role of scientists in society. Studies in the research literature speak to the need for greater emphasis in text books and mass media on the human aspects of science. Three recent science textbooks (Altıntaş, 2012; Topaloğlu, 2012; Gündoğdu, 2012) selected for examination contain images of real scientists. For example, in the 8th grade textbook there are seven reading selections about the work of scientists, complete with photographs; in the 6th grade text book there are three reading selections with photographs similar to the fifth grade text book. In contrast, in five text books (Yalçın et al., 1993; Yalçın et al., 1997; Yalçın, et al. 1998a; Yalçın et al., 1998b; Yalçın et al., 1998c), selected for examination in 2000 study, which are all endorsed by the Ministry of Education and all widely used at that time, there was not a single drawing or photograph of a scientist. Students then had to form their own incomplete and mostly stereotyped images. Textbooks recently published in Turkey seem to be meeting the need better than earlier text books. Hence the smiling and more realistic images of scientists produced in the recent study may have been influenced by newer and better science text books.

Conclusions and Implications

Children are full of enthusiasm and curiosity about the work of scientists but seem to lose their enthusiasm as they continue in school (Flick, 1990; Friedman, 1999). How does this happen? Some part of the answer resides in the study of attitude and attitude change. Attitudes form through accumulated experiences over time. They are relatively enduring, but can and do sometimes change. Teachers must learn how to transform stereotyped images of science and scientists instead of reinforcing them and must motivate themselves to teach in a non-sexist way (Hilliard, 1975; Mc Cune & Matthews, 1975). During this process the DAST can be used as a pre- and/or post-test to detect a change of attitude/value from the beginning to the end of a course or series of courses. The instrument requires no reading or writing



and takes little time to administer. It can also stimulate an interesting and productive instructional activity, as students share and discuss their drawings with their classmates and their teacher. This kind of activities will give pupils an opportunity to think about and test their images about scientists.

In the Turkish educational system, from kindergarten to 3rd grade, science is integrated with other subjects under the heading of *Life Sciences*. In 4th grade and after, science is taught as a separate subject. It is a centralised educational system; the same curriculum materials as text books are used in state supported schools throughout country. Because of that reason teachers as well as the textbook authors must be aware of the important characteristic of scientifically literate citizen as having positive attitudes toward science/scientists and they must use the results of related research studies in conducting practices.

Teachers and curriculum specialists must be sensitive about the attitudes of females related to science and scientists. In general even if the images of students related to scientists were more positive in comparison to the ones 12 years ago, students still need opportunities for having to develop scientifically literate attitudes toward scientists. The stereotypical role of women in science is still remains as an important topic for researchers to investigate.

In the light of the results of the current study as well as the review of the literature described in this study it is recommended that a wider view of science including;

- science done by women,
- an awareness that science activities are not limited with the walls of laboratory, but may take place in a numerous of settings,
- an insight of the importance of team work in conducting scientific work, should take place in formulating science instruction/textbooks.

In that respect the values of science teachers are very important for planning teaching learning activities which promote opportunities for their students to develop scientific literacy.

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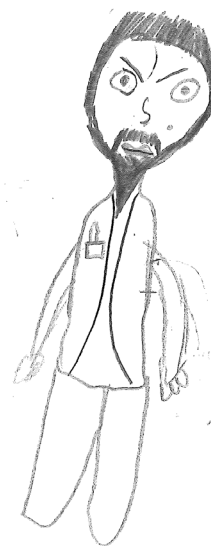


Figure 4: Angry scientist.

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