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Children's Images of Scientists: Does Grade Level Make a Difference?*

Murat ÖZEL[a]
Nigde University

Abstract

The purpose of this study was to assess children's images of scientists by using the Draw-A-Scientist Test and to determine if differences in these images exist between grade levels. The DAST was administered to 243 children who were enrolled in kindergarten (aged 6) and grade 3 and 5 (aged 9 and 11). Findings obtained from the study revealed that, in general, children possess stereotypical views of scientists using the DAST with their drawings displaying fewer indicators of the stereotypic model on average. Results indicated that there are significant differences in students' stereotypical images of scientists depending on grade level. The results also showed that fifth grade students created images of scientists with more stereotypical elements compared to drawings created by students in kindergarten and grade 3.

Key Words

Draw-A-Scientist Test (DAST), Scientists, Children, Science Education, Grade Level.

The emphasis in science education has generally not focused on "preparing future scientists" towards a "science for all students" approach (Yore, 2011). In this respect, many countries around the world have given greater importance to the teaching of science, technology, engineering, and mathematics disciplines (STEM) in order to encourage students to consider a career in these disciplines in the future. It is generally accepted that there is considerable interest among science educators in the science education literature on the importance of students' perceptions of scientists. Perceptions of scientists can be viewed as the first step in considering future careers in STEM (Painter, Tretter, Jones, & Kubasko, 2006). Hence, it is even more important that students have accurate conceptions of what science is and what scientists do.

Students' stereotypical views about scientists may guide to perceptions that can negatively or positively influence students' attitudes for a future career. In general, students' images of scientists are often accepted as one of the important factors that influence students' interest, attitudes toward learning science and having science-related careers in the future (Boylan, Hill, Wallace, & Wheeler, 1992). These perceptions in a positive or negative manner greatly influence the number of the students interested in studying science and having a career related to science (Buldu, 2006; Finson, 2003; Finson, Beaver, & Cramond, 1995; Fung, 2002; She, 1998). Several researchers have also reported that students' perceptions about a scientist seemed to affect their willingness to become a scientist (e. g., Finson, 2003; Finson et al.). For instance, stu-

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a **Murat ÖZEL, Ph.D.,** is an instructor in the Department of Science Education at Nigde University, Turkey. He received a PhD in science education from Gazi University. His research areas include pedagogical content knowledge, biotechnology education, students' perceptions of scientists, and students' conceptions of science. Correspondence: Dr. Murat ÖZEL, Department of Science Education, College of Education, Nigde University, 51100, Niğde/Turkey. E-mail: muratozel@nigde.edu.tr, mozeltr@gmail.com Phone: +90 506 493 8891 Fax: +90 388 211 2800.

dents who hold negative images of scientists would be less likely to consider science as an interesting subject or as a career option that they may like to pursue in the future.

Researchers studying perceptions of scientists (Newton & Newton, 1992) reported that students begin to form stereotypical images of scientists at kindergarten and elementary school (e. g., Losh, Wilke, & Pop, 2008; Matkins, 1996). Results from previous research have shown that stereotypical images and perceptions about scientists differ relating to the students' education level (Finson, 2002; Losh et al.; Medina-Jerez, Middleton, & Orihuela-Rabaza, 2010). Moreover, previous studies have not examined how stereotypical views that are held by elementary students might be influenced by their formal experiences in science. Therefore, the present study aimed to compare kindergarten and grade 3 and 5 children's images of scientists by grade level.

Literature Review

Since the pioneering work of Mead and Metraux's (1957) which investigated high school students' descriptions of a scientist, researchers have examined students' perceptions of scientists at all levels. Research studies in this domain have typically focused on what students' perceptions of scientists are. Many studies have been conducted to discern these perceptions (e. g., Barman, 1999; Buldu, 2006; Cakmakci et al., 2010; Christidou, 2010; Christidou, Hatzinikita, & Samaras, 2010; Finson et al., 1995; Fung, 2002; Kaya, Doğan, & Öcal, 2008; Koren & Bar, 2009; Long & Steinke, 1994; Losh et al., 2008; Medina-Jerez et al., 2010; Newton & Newton, 1992; Newton & Newton, 1998; Song & Kim, 1999; Turkmen, 2008).

Studies that have investigated students' images of scientists have also indicated that students begin to form stereotypical images of scientists at elementary school (e. g., Losh et al., 2008; Matkins, 1996). In this respect, many studies have been conducted to elucidate primary children' images of scientists. In one of the research studies, Newton and Newton (1998) investigated primary children's views of scientists in the UK. They found that perceptions of scientists did not differ amongst primary school children. Their results indicated that there is still a gender-biased stereotype. Fung (2002) aimed to explore Hong Kong Chinese primary (2, 4, and 6) and secondary (2, 4/5) school students' images of scientists. The results of this study indicated that students developed a more stereotypical image of scientists with age and scientists were drawn predominantly as males. Silver and Rushton (2008) examined Year 5 primary-school children's images of scientists and their attitudes toward science, engineering and technology (SET). Their results revealed that students enjoyed science and creative activities in school and had positive attitudes towards SET outside school but did not wish to become scientists or engineers. The researchers concluded that there is a need to provide more positive images of the work of scientists.

In a study, Losh et al. (2008) investigated elementary school students' conceptualization of scientists. They included other images of professionals as well in addition to scientists. They asked students to draw a teacher, scientist and veterinarian. Their results suggest that students clearly distinguished among different professionals; for example, scientists smiled less and were scored as less attractive than teachers and veterinarians. Students in this study drew teachers as most attractive and largely female, and scientists as most often male and least attractive. The researchers concluded that scientists do have an "image problem" among students. Another interesting finding is that students in higher grades drew no more attractive or detailed images than lower grade students. A study conducted by Türkmen (2008) investigated fifth grade students' images of scientists and factors that influence students' perceptions of scientists by using the DAST instrument. The results of this study showed that scientists are male, Caucasians, elderly-aged and often working indoors. The results also showed that smiling scientists and indicator of technology symbols have. Korkmaz and Kavak (2010) investigated primary school students' (grades 4-8) images of science and scientists. They found that scientists are males, wearing lab coats, and having eyeglasses. The researchers concluded that Turkish students have typical stereotypical images of scientists. Oğuz-Ünver (2010) compared the perceptions of scientist held by fifth grade elementary students' and preservice teachers. Her results showed that preservice teachers' perception of scientists were more stereotypical than those of fifth grade students. She concluded that fifth grade students were closer to being scientists than preservice teachers.

The results of these studies indicate that there are similar images of scientists; scientists are most often portrayed as middle aged men, wearing lab coats, glasses, and working in a laboratory. However, most of the studies provided no information on the sig-

nificance of each grade level in comparison with each other on students' perceptions of scientists. Moreover, only a few of these studies specifically addressed how these perceptions significantly differed according to grade level. In the research literature, it is not clear how grade level influences these perceptions of scientists (Finson, 2002). Available literature indicates that very few studies attempt to explore the role of grade level on students' images of scientists based on the DAST instrument. Since differences among grade levels have not been widely studied in the research literature so far, this paper attempts to explore the effect of grade level and thus to fill that gap in the literature. Consequently it is important to detect children's stereotypes in order to prevent their lack of interest in science and avoidance of science careers. Thus, an increased understanding of elementary students' images of scientists would enable science educators to develop science curricula that will change students' stereotypical images of scientists. Exploring students' perceptions of scientists may provide valuable information in terms of curriculum development and instructional practices. With this in mind, this study investigated kindergarten and grade 3 and 5 students' perceptions of scientists through their images and whether or not these perceptions differed significantly among grade level.

Research Questions

This study aimed to explore the views of scientists held by kindergarten and grade 3 and 5 students? by using the DAST. This study was designed to identify the extent to which kindergarten and elementary students hold stereotypical views of scientists and to examine how those stereotypical images might be influenced by grade level. The following research questions established the direction of the research:

- What are the views of scientist that are held by kindergarten (aged 6) and grade 3 and 5 students?
- Do these perceptions significantly differ among grade level?

Method

This study employed quantitative and qualitative approach to investigate students' images of scientists and how those images might be affected by grade level (Creswell, 1994). Data were collected and analyzed using students' drawings based on the DAST instrument.

Data Collection

A Draw-a-scientist-test (DAST), which was originally developed by Chambers (1983), was used to determine students' images of scientists. In the DAST, students are typically asked simply to draw their perceptions of a scientist. This allows students to simply reflect their impressions about scientists in their drawings. It has been used effectively to reveal and assess perceptions toward scientists through numerous studies which have shown consistent results (Chambers; Finson et al., 1995; Monhardt, 2003; Newton & Newton, 1992). Some researchers have researched methodological aspects of the DAST instrument (e. g., Losh et al., 2008). However, considering the widespread use of the DAST in published articles indicates that it is still accepted as a reliable tool for collecting students' perceptions of scientists.

The DAST instrument involves a range of main and sub-categories for students' drawings, which includes physical properties, scientific equipment, signs, context, gender, and facial expression. Schibeci and Sorensen (1983) indicated that the DAST instrument, as not requiring reading and writing, takes very little time to administer. It also presents a detailed list of stereotypical elements likely to be found in pictorial representations of scientists drawn by students.

Participants

The participants of this study were students who were enrolled in an elementary school in the city of Ankara, Turkey. A total of 243 students from an elementary school were invited to participate in the study. Participants included 85 kindergarten (25 male, 60 female), 119 third grade (64 male, 55 female), and 39 fifth grade (17 male, 22 female) students. Approximately more than half of the participants were female. Of the participants, 106 were male and the rest of them (137) were female. Kindergarten students were between 6-7 years old. Grades 3 and 5 students were 9/10 and 11/12 years old, respectively.

Procedure

The researcher invited students to participate in this study. Students who accepted to attend the study were given a blank worksheet that included a large framed area. Students were asked to draw "a scientist at work". Students were explicitly instructed to draw scientists as they depicted them, rat-

her than just to "draw a scientist", as in Chambers' original study. It is believed that such an instruction would encourage students to better express their own views. Students were also asked to type name of scientists they drew. In addition, students were asked to clarify their drawings through their own sentences. No other guidelines and restrictions were given. It was observed that each student completed his\her drawing in approximately 30 minutes. There was no time limit for completing the drawings. Students indicated their class level, age and gender on at the beginning of their drawings. The DAST was administered by the science teacher in one of his lesson. All data were collected in the fall semester of 2011 school year.

Data Analysis

The checklist suggested by Finson et al. (1995) was used for scoring students' drawings. During the analysis stage, the author of this paper and a research assistant began by using the original DAST to score students' drawings. This analysis procedure was applied to each drawing in order to score all drawings and collect additional information on students' drawings. This secondary analysis provided useful information about students' drawings. We noted that the presence of beard, moustache and tie indicators in the images. Hence, we added these indicators to our checklist. The final checklist is shown in the Appendix. This checklist was used to score all images independently. Students' drawings were analyzed by the author of this paper and a research assistant. When scoring a DAST drawing, we used the rater codes for each indicator with either 1 or 0 points depending on the presence or absence of the feature under examination in the checklist. Higher scores on the DAST point out highly stereotypical images, while lower scores indicate less stereotypical representations of scientists. As part of the coding procedure, the rater also made notations in case information such as scientists working in collaboration or a female scientist who plays a primary or secondary role is portrayed in the drawing. Accordingly, the correlation of inter-rater reliability was calculated to be 0.91. Differences were discussed until we reached consensus for all drawings. The statistical package for social science software was used to calculate the descriptive statistics. The scores were entered to the SPSS file to make further descriptive analysis through the use of Statistical Package for Social Science software. One way ANOVA and Chi-squared tests were used to investigate students' drawing scores across different grade levels in terms of images of scientists.

Figure 1 is an image that was drawn by a grade fifth student in response to the DAST. The figure shows a scientist who is male, wearing lab coat and glasses while working alone in a laboratory setting. For example, the drawing in Figure 1 received a physical appearance score of 2 and a scientific knowledge score of 1. The drawing in Figure 1 was scored male and inside.

Figure 1. *A Stereotypical Image Drawn by a Grade 5 Student*

Results

Table 1 shows the number and percentage of participants who included specific elements in their drawings of scientists. A greater percentage of kindergarten and grade 3 students (19% and 18%, respectively) drew a lab coat compared to grade 5 students (8%). A larger percentage of grade 5 students (36%) included eyeglasses in their drawings, while a lower proportion of kindergarten and grade 3 students (11% and 18%) indicated eyeglasses. A larger percentage of grade 3 students (9%) included facial hair in their drawings compared to students in kindergarten and grade 5 (1% and 3%). A greater percentage of kindergarten and grade 5 students (11% and 23%) drew relevant captions compared to grade 3 students (2%). A greater percentage of students drew a beard (0-15%), moustache (1-25%), and tie (2-25%). In particular, a greater percentage of grade 5 students included these elements in their drawings compared to students in kindergarten and grade 3.

Almost half of the students in all the grades (28-49%) included technology symbols in their drawings. A greater percentage of students in all the grades (47%, 36%, and 50%, respectively) inclu-

Table 1.

Children' Scores for DAST-C Indicators based on Grade Level

Category	Indicator	Kindergarten *N* = 85		Grade 3 *N* = 119		Grade 5 *N* = 39		All Participants *N* = 243	
		n	%	n	%	n	%	n	%
Physical appearance	Lab coat	16	19	22	18	3	8	41	17
	Eyeglasses	9	11	22	18	14	36	45	19
	Facial hair	1	1	11	9	1	3	13	5
	Beard	0	0	1	0	6	15	7	3
	Moustache	0	0	2	1	10	25	12	5
	Tie	4	4	4	2	10	25	18	7
Scientific Knowledge	Research instruments (specify types and sizes)	40	47	44	36	20	50	104	43
	Technology	34	40	58	49	11	28	103	42
	Scientific captions	9	11	4	2	9	23	22	9
Light bulbs		4	5	2	1	1	3	7	3
Signs of danger		0	0	0	0	0	0	0	0
Indications of secrecy		0	0	0	0	0	0	0	0
Happy		40	47	38	32	6	15	84	35
Unhappy		0	0	0	0	0	0	0	
Angry		1	1	1	0	1	3	3	1
Thoughtful		3	3	9	8	7	18	19	4
Crazy		12	14	32	27	20	51	64	26

ded research symbols in their drawings. Drawings also included images of personal characteristics of scientists. A large percentage of grade 5 students (51%) drew a crazy image of scientists; kindergarten and 3 students (14% and 27%, respectively) indicated that their scientist was crazy. None of students drew a scientist as unhappy. Grade 5 students (18%) drew a scientist as thoughtful. Nearly half of kindergarten students (47%) drew a scientist as happy, when compared to the percentage of grade 3-5 students (32% and 15%).

A large percentage of students in all grades included a male (45.8-79.4%) in their drawings (see Table 2). However, a lower percentage of the students in all grades (17.9-44.7%) drew scientists as female in their drawings. These findings demonstrate that there are strong preferences for male scientists. In a small proportion of the drawings, the gender of the scientists was not determined. Researchers were most frequently depicted as working indoors (37.6%, 16.8%, and 35.8%, respectively). However, a large percentage of drawings included no place for scientists' activities.

Table 2.

Children's Scores for Gender and Location Indicators based on Grade Level

	Kindergarten *N* = 85		Grade 3 *N* = 119		Grade 5 *N* = 39	
	n	%	n	%	n	%
Gender						
Male	39	45.8	85	71.4	31	79.4
Female	38	44.7	30	25.2	7	17.9
Unknown	8	9.4	4	3.3	1	2.5
Location						
Indoors	32	37.6	20	16.8	14	35.8
Outdoors	15	17.6	10	8.4	5	12.8
Unknown	39	45.8	90	75.6	19	48.7

Chi-Square Homogeneity test showed that there is a statistically significant difference across grade levels in terms of students' preference for gender of scientist (χ^2 (4)=42.095> χ_{cv}^2(4)=18.47 p<0.001). Also, Chi-Square Homogeneity test shows that students' preference for location of scientist is affected by their grade levels χ^2 (4)=214.22 > χ_{cv}^2(4)=18.47 p<0.001.

In order to reveal clear differences between grade level and students' scores for physical appearance and scientific category scores were calculated. A statistical analysis of physical appearance and knowledge scores can be found in Table 3.

Table 3.
Statistical Analysis of Students' Scores for Physical Appearance and Knowledge

	Kindergarten ***N* = 85**		**Grade 3** ***N* = 119**		**Grade 5** ***N* = 39**	
	Mean	SD	Mean	SD	Mean	SD
Appearance	.35	.702	.52	.832	.90	1.071
Knowledge	.98	.654	.89	.635	1.03	.778

Grade 5 students included a greater number of indicator elements for physical appearance and scientific knowledge than kindergarten and grade 3 students.

A one-way analysis of variance (ANOVA) was used to determine the effect of grade level on physical appearance scores. There was a significant effect of grade level on students' physical appearance scores at the p<.05 level [F(2, 240)=5.70, p=.004] (see Table 4).

Table 4.

Results of One-Way ANOVA Test for Students' Physical Appearance Scores

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7.927	2	3.963	5.706	.004
Within Groups	166.699	240	.695		
Total	174.626	242			

Table 5.
One-way ANOVA Results for Students' Physical Appearance Scores across Different Grade Levels

Grade	Grade	Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
K	3	-.168	.118	.332	-.45	.11
	5	-.544*	.161	.002	-.92	-.16
3	K	.168	.118	.332	-.11	.45
	5	-.376*	.154	.040	-.74	-.01
5	K	.544*	.161	.002	.16	.92
	3	.376*	.154	.040	.01	.74

Note: K=Kindergarten

In order to determine whether there is a statistically significant difference for means of physical appearance scores among grade levels, a Tukey test was conducted. test was conducted (see Table 5). The results indicated that there was a statistically significant difference in the average physical appearance scores among grade levels. There was statistically difference between kindergarten and fifth grade (p<.001). Also, there was statistically difference between third and fifth grades (p<.05). However, there was no statistically difference between kindergarten and third grade (p>. 05).

Table 6.
Results of One-Way ANOVA Test for Students' Scientific Knowledge Scores

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.686	2	.343	.773	.463
Within Groups	106.507	240	.444		
Total	107.193	242			

A one-way analysis of variance (ANOVA) was used to find out the effect of grade level on scientific knowledge scores (see Table 6). There was no significant effect of grade level on students' scientific knowledge scores [F (2, 240) =5.70, p>.05].

Table 7.
One-way ANOVA Results for Students' Scientific Knowledge Scores across Different Grade Levels

Grade	Grade	Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
K	3	.086	.095	.637	-.14	.31
	5	-.049	.129	.923	-.35	.25
3	K	-.086	.095	.637	-.31	.14
	5	-.135	.123	.517	-.42	.15
5	K	.049	.129	.923	-.25	.35
	3	.135	.123	.517	-.15	.42

Note: K=Kindergarten

Table 7 shows that there was no statistically significant difference in the average means of scientific knowledge scores among grade levels (p > .05). This

Table 8.
Students' Depictions for Scientists' Actions by Grade Level

Scientists' actions	Kindergarten		Grade 3		Grade 5		All Participants N = 243	
	N = 85		N = 119		N = 39			
	n	%	n	%	n	%	n	%
Repairing/manipulating tools	8	8	0	0	1	2	9	3
Inventing and designing a new material	55	55	101	76	24	50	180	64
Doing experiments	20	20	23	17	19	40	62	22
Explaining and teaching a subject	3	3	3	2	0	0	6	2
Doing observations	10	10	6	5	2	4	18	7
Other (nothing)	4	4	0	0	2	4	6	2
N	100	100	133	100	48	100	281	100

finding suggests that scientific knowledge scores is not affected by the grade level.

As can be seen from Table 8, a major percentage of students in kindergarten and grade 3 and 5 (55%, 76%, and 50%, respectively) indicated that they drew a scientist who was inventing and designing a new material. Most of drawings and explanations included general statements of scientists who were inventing something new and doing experiments. The predominant explanation for the scientist conveyed a scientist who was inventing a new material and doing experiments. A larger percentage of grade 5 students (40%) drew a scientist experimenting, when compared to the percentage of kindergarten and grade 3 students (20% and 17%). A small percentage of kindergarten students (10%) indicated that their scientist was doing observations, while even a smaller percentage of Grade 3 and Grade 5 students indicated a scientist observing. Interestingly, a small percentage of kindergarten (8%) students indicated that their scientist was doing repairing, when compared to the percentage of Grade 3 and Grade 5 students (0% and 2%). On the other hand, a small proportion of students in kindergarten and grades 3 and 5 (3%, 2%, and 0%, respectively) indicated that scientists taught a subject.

Table 9 reveals the strength of the association between the categorical score for physical appearance and the grade level. As can be seed from Table 5, a large percentage of students in all the grades (49-74%) received 0 score from their drawings. This finding means that a large percentage of students did not include any physical appearance features in their drawings. The results in Table 10 demonstrate that the majority of scores for scientific knowledge were between 0 and 1 across all grades. The most important finding is that more students in grade 5 received higher scores for physical appearance in their drawings of scientists and more students in kindergarten had lower scores.

In this study, I analyzed kindergarten and grade 3 and 5 students' scientific knowledge scores of scientists based on the modified DAST-C. As can be seen from Table 6, grade level did not significantly

Table 9.
Stereotypical Physical Appearance Scores for Students' Images of Scientists According to Grade Level

Physical appearance score	Kindergarten N = 85		Grade 3 N = 119		Grade 5 N = 39		All Participants N = 243	
	n	%	n	%	n	%	n	%
0	63	74	77	65	19	49	159	65.4
1	16	19	27	23	10	26	53	21.8
2	5	6	11	9	6	15	22	9.0
3	0	0	3	2	4	10	7	2.8
4	1	1	1	1	0	0	2	0.8
N	85	100	119	100	39	100	243	100

Table 10.
Stereotypical Scientific Knowledge Scores for Students' Images of Scientists According to Grade Level

	Kindergarten		Grade 3		Grade 5		All Participants *N* = 243	
Knowledge score	***N* = 85**		***N* = 119**		***N* = 39**			
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
0	18	21	30	25	11	28	59	24.2
1	52	61	73	61	16	41	141	58.0
2	14	17	15	13	12	31	41	16.8
3	1	1	1	1	0	0	2	0.8
4	0	0	0	0	0	0	0	0
N	85	100	119	100	39	100	243	100

impact upon indications of scientific knowledge in students' drawings of scientists. Findings in Table 10 demonstrate that the majority of scores for scientific knowledge were between 0 and 1 across all grades. A lower percentage of scores included 3. When looked at grade level based on 3 score of 3, appeared that grade 5 students achieved a score of 3 in their drawings. However, none of students' drawings were scored as 4.

Discussion

The purpose of this study was to examine kindergarten and grade 3 and 5 students' perceptions of scientists through their images. Data analyses in this study focused on determining the stereotypical perceptions of scientists that are held by elementary school students and whether these perceptions significantly differed among grade level. In this study, the physical appearance score was chosen as the major indication of a stereotypical image of a scientist. The findings of this study indicated that, in general, elementary students possessed stereotypical views of scientists according to their drawings using the DAST and students' drawings included fewer indicators of the stereotypical model on average. In addition, results demonstrate that grade 5 students included a greater number of indicator elements for physical appearance and scientific knowledge than kindergarten and grade 3 students. There was a significant effect of grade level on students' physical appearance scores. However, there was no significant effect of grade level on students' scientific knowledge scores.

In terms grade level, findings show that there was a statistically significant difference in the average physical appearance scores among grade levels, while there was no statistically significant difference in the average means of scientific knowledge scores among grade levels. The findings also showed that students' physical appearance scores are influenced by grade level, while scientific knowledge scores is not affected by the grade level. In addition, it was found that there is a significant difference students' preference for gender and location of scientist across grade levels.

A majority of students drew research symbols accompanying their scientist. The predominant research symbol in students' drawings included test tubes and beakers. The findings also revealed that, as in previous studies, scientists wear lab coats and eyeglasses. The preference for a lab coat is important considering elementary students' drawings. As previous research findings (Barman, 1999; Buldu, 2006; Chambers, 1983; Fung, 2002; Christidou et al., 2010; Quita, 2003) indicated, the most common outcome was drawing scientists as someone who wears a lab coat. A possible reason may stem from the influence of textbooks, the mass media, and especially cartoons. As recommended by (Monhardt, 2003), how scientists are presented in textbooks greatly influences what students believe about scientists.

The findings obtained from this study showed that grade 5 students held more stereotypical views than did students in the lower grades. This finding is consistent with the findings of previous research (Barman, 1999; Chambers, 1983; Finson et al., 1995). These research studies found that older students have more stereotypical views of scientists. One possible explanation for the lower stereotypical views held by grade 5 students could be attributed to their increased experience with science lessons.

In addition, a great majority of students drew scientists as males. This preference for male researchers is particularly important because it reveals the role of females in a given culture and/or male-biased presentation of scientists. This finding is consistent with previous research findings (Bul-

du, 2006; Chambers, 1983; Finson, 2002; Losh et al., 2008; Quita, 2003; She, 1998; Turkmen, 2008). The reason might be that scientific knowledge presented in schools, textbooks, and cartoons is predominantly constructed by male scientists such as Einstein and Newton. Similarly, it was observed in this study that students typed names of the scientists such as Einstein and Newton. The lack of females as lead scientists in both prior studies and this study reflects the need for emphasizing female scientists who can be role models for students. In particular, the lack of these role models may lead a wrong message for girls (i.e., the most accomplished scientists are male). Teachers should introduce more examples of female scientists to children. This introduction would probably encourage female students to be interested in a science career.

Students depicted scientists as working indoors. While this finding is consistent with the findings of several research studies (Barman, 1999; Buldu, 2006; Chambers, 1983; Mead & Metraux, 1957; Turkmen, 2008) showing that research is predominantly imagined as preformed in laboratories, the present finding disagrees with those of Christidou et al. (2010) suggesting that research is predominantly performed in fieldwork. It could be said that students depicted scientists as someone who worked alone in a laboratory. This finding suggests that there is a need to highlight that scientists can work together in scientific research.

By analyzing students' written explanations of what the scientist was doing in their drawings, a majority of students indicated that the scientist was inventing and designing a new material. A small percentage of students depicted scientists who were explaining and teaching a subject and making observations. However, it should be noted that such a view is not unusual in representations of scientists who are working in the field of social sciences. This finding shows that the social dimension of scientific research is missed in the representations of scientists by students. Therefore, this finding indicates a restricted image of scientists and scientific research (Buldu, 2006; Finson, 2002; Rubin, Bar, & Cohen, 2003). Why do students not think of a scientist as a social scientist? Why are scientists not represented as the ones who are working at a library and struggling to write a book, journal or newspaper article? Findings in this study clearly demonstrate that there is a need to point out that there is a social aspect of scientific research and social scientists struggle and discuss to solve the problems that we have encountered in daily life.

Conclusions

This study showed that elementary (kindergarten, grade 3 and 5) students' had a variety of stereotypical images of scientists and these stereotypic images are more in the grade 5 students compared to kindergarten and grade 3 students. In general, students' drawings of scientists indicate that the image of a scientist who is male, wearing lab coat and glasses while working alone in a laboratory setting. Also, students drew fewer indicators of scientists in their drawings. It is crucial that in order to promote a less stereotypical image of scientists, teachers should employ a variety of activities in their lessons by including visits to scientists who represents both social-related and science-related occupations, facilitating a scientist's visit to the classroom, presenting scientists' live, organizing field trips that contain the works of scientists, giving details about scientist's works, working as a team in classroom, and bringing more books to the classroom that have relevant stories of scientists. Each of these experiences would make great contribution on what perceptions students have of scientists. Students will then acquire more concrete examples so that they can make more connections between school and daily life. Rather than teachers' instruction on what a scientist does, it would be very beneficial if teachers design such experiences for their students. Thus, many students can start to view scientists as more realistic and positive rather than as mythical people.

It would be important to mention here that the negative scientist characters such a 'mad scientist' or a 'man in lab coat' in cartoons and TV programs may be the cause of the formation of negative images of scientists. Further research is necessary to measure the effects of media on children's images of scientists. The formation of this negative image in students could prevent students not only in becoming a scientist (e. g., Finson, 2003; Finson et al., 1995) but also in having a career in science. The reason may be that children often interact and identify with the people and characters that appear on television. The findings of this study suggest that there is a need to show that scientists are really working on topics associated with our everyday lives.

The findings of the present study indicate that there is a need to highlight that science is a part of our daily lives, a subject that everyone can be actively involved in, and that scientists are like normal people. Further research should investigate elementary students' perceptions of scientists and what factors affect students' images through a variety of

data collection tools, including the DAST, interviews, and Likert-type questionnaires. Moreover, in order to help students to build an inclusive image of scientists, there is a need to carry out experimental studies.

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Appendix.

Scoring Checklist Based on the DAST-C

Category	**Item**
Physical appearance	Lab coat
	Eyeglasses or Goggles
	Facial hair
	Wild hairdo
	Beard
	Moustache
	Tie
Scientific knowledge	Research instruments (specify types and sizes)
	Technology (computers, TV, rockets)
	Scientific captions
Gender	a. Male
	b. Female
	c. Indeterminate
Work environment	a. Indoors
	b. Outdoors
	c. Indeterminate
Age	a. Middle aged or elderly
	b. Indeterminate
	c. Child
Other	Indications of danger
	Light bulbs
	Mythic stereotypes
	Indications of secrecy
	Other comments