Still persistent global problem of scientists' image

Hakan TÜRKMEN

Ege University, Faculty of Education, Department of Elementary School Education, Science Education Bornova, 35100, Izmir, TURKEY

E-mail: hakan.turkmen@ege.edu.tr

Received 2 Feb.., 2015
Revised 15 Jun., 2015

Contents

Abstract

Per-service teachers' views of science and scientists have been widely studied. The purpose of this study is to identify whether there is problem of image of scientists and determine where they receive about scientist image. Three hundred thirty five (105 from Turkey, 162 from Europe, 68 from US) elementary pre-service teachers participated in this study. This study showed that pre-service teachers perceived about stereotypic scientist indicators which are "Caucasians", have "facial hair", and

indicator of "symbols of research" and "symbols of knowledge", "technology" were almost same percentage. Moreover, there often is a lack of perspective in "Indications of Danger", "Indications of Secrecy", and "Mythic Stereotypes". The ethnic minority representation was the minimum rate. All pre-service teachers think that highest sources of image of scientist are orderly teacher, parents, friends, and media, but parents friends and media are not very crucial source for Turks as much as Europeans and the Americans. Both groups were influenced to a considerable degree by teachers, the content of science textbooks and books, this study illustrated the possible impact of the curriculum. The impact of science teachers and textbooks has shaped what a scientist is and what a scientist does. However, field trip and assessment, and projects related scientist are not common in science lessons. The view of Turkish pre-service teachers is less focused on them than Europeans' and the Americans. Eventually, stereotypical images of the scientist are a slightly lesser than revealed in previous studies but stereotypes of scientists are widely persistent even among elementary preservice teachers. Pre-service elementary teachers' images of scientists and attitudes toward science may be affected by the way science is taught in their teacher education programs. The most recent primary level of science curriculum programs includes activities to engage students in the manner of constructivist approach for the US, European countries and Turkey. Results showed that if how effective using this educational perspective elementary pre-service teacher' minds will be touched and they will complete understanding of what science and a scientist is in their minds.

Keywords: The Draw-a-Scientist Test (DAST); Science teaching; Scientist

Introduction

There is no doubt the image of scientists is a part of science. The first study of drawing scientist was come by anthropologist M. Mead and medical researcher R. Metraux (1957), who had given 35,000 high school students the task of writing an essay depicting their image of a scientist in 1957. After their study, David W. Chambers (1983) created the Draw-a-Scientist Test (DAST) via analyzing of 4807 children in order to learn the person's image of a scientist. Drawings were analyzed for seven indicators, lab coat, eyeglasses, facial growth of hair, age and grade level, of the image that children held stereotypical views of scientists. Symington and Spurling realized that students draw represent what they perceived to be the public stereotype of a scientist instead of their own perception of a scientist, they revised

DAST and named the Draw-a-Scientist- Test revised prompt (DAST-R) (1990). They added "Do a drawing which tells what you know about scientists and their work" section. Then they tested and compared students' drawings given both sets of prompts. There were found the enough differences that the DAST prompt is critically examined for what it actually is asking the students to draw. Nowadays, the most common technique used to identify students' images of scientists is the Draw-A-Scientist Checklist (DAST-C) developed by Finson, Beaver, and Cramond (1995).

Meanwhile many researchers had been using DAST to determine various factors in students, including perceptions of scientists at the elementary through high school level, and perception of technology, career goals, and gender differences in 1980-90's (Barman, 1996; 1997; 1999; Bodzin & Gehringer, 2001; Chambers, 1983; Chiang, & Guo, 1996; Finson, 2002; 2003; Finson, Beaver & Crammond, 1995; Finson, Pedersen & Thomas, 2006; Flick, 1990; Fort & Varney 1989; Fung, 2002; Huber & Burton, 1995; Jane, Fleer, & Gipps, 2007; Koren & Bar, 2009; Monhardt, 2003; Moseley & Norris, 1999; Newton & Newton, 1992; Schibeci & Sorenson, 1983; She, 1995; 1998; Song & Kim, 1999; Symington & Spurling, 1990; Türkmen, 2008) . Each of these studies has shown that students have interesting stereotypic images of scientists in their minds. The common finding was that scientist is white men, who wears a white coat and glasses, has weird smile, funny hair, and wild eyes, works alone in a laboratory or basement, and also are elderly or middle aged. This has been interpreted as showing strong confirmation of a stereotype of the scientist by many researchers (Chambers 1983; Finson, Beaver & Cramond 1995; Fort & Varney 1989; Huber & Burton 1995; Matkins, 1996; Newton & Newton, 1992; Parsons, 1997; Schibeci & Sorenson 1983). Variations of the DAST have been utilized in not only in the U.S and UK but even there were limited studies reporting the image of the scientist from other countries; such as Korea (e.g., Song & Kim, 1999), Taiwan (e.g., Chiang, & Guo, 1996; She, 1995-1998), Hong Kong (e.g., Fung, 2002), Turkey (e.g., Turkmen, 2008), Finland (e.g., Raty, 1997), Ireland (e.g., Maoldomhnaigh & Hunt, 1990), Israel (e.g., Rubin, & Cohen, 2003; Koren & Bar, 2009), those studies agreed that stereotypical images of the scientist seemed to be common worldwide.

Analyzing students' images of scientists has crucial implications for understanding students' perceptions of scientists and their role in society. This research perspective may affect students' attitudes and interest in learning science, and may even affect

whether or not they continue to study science and select jobs related science. According to Oakes (1990), students must choose the science "pipeline" early in their educational careers in order to achieve the training necessary for science careers. For that purpose they need to have consistent role models using proper teaching methods in science lessons. If a student cannot picture herself as a scientist or/and has stereotypical image of a scientist, s/he will not probably enter science careers (Monhardt, 2003; Finson, 2003).

Many western countries started to modify or reform their science education curriculum and program in the 1990's, such as the US, UK, Turkey, Spain, Portugal, Sweden, Greece, because the international research studies, such as TIMSS and PISA, showed that many modern country are not on the top list, even worse they are under the average and/or around average. In the Table 1 some countries TIMSS and PISA scores are the indicator to understand why these countries need to make revision their education system. These results pushed most of countries to evaluate their education system and reform it. Of course these types of international results do not definitively show that education system of one is better than other, but these results give us a clue to assume there is a problem in education system. Countries must think why our students could not succeed in these international research studies. In this obligation, the European Union (EU) and the US have influenced on many countries education policies not only in terms of resources but in enhancing the quality of countries education.

Table 1. TIMSS and PISA 8th grade science results of participants

Country	1999 TIMSS (38participants)	2003 TIMSS (49participants)	2007 TIMSS (49participants)	2000 PISA (43participants)	2003 PISA (41participants)	2006 PISA (57participants)
Turkey	33. rank	-	31. rank	-	35. rank	46. rank
US	18. rank	10. rank	11. rank	15. rank	22. rank	36. rank
Belgium	12. rank	17. rank	-	18. rank	14. rank	24. rank
Netherland	6. rank	9. rank	-	-	8. rank	11. rank
Greece	-	-	-	26. rank	30. rank	35. rank
Czech Republic	8. rank	-	7. rank	12. rank	9. rank	17. rank
Bulgaria	17. rank	25. rank	24. rank	31. rank	-	43. rank
Poland	-	-	-	22. rank	19. rank	23. rank

Latvia	20. rank	19. rank	-	28. rank	25. rank	25. rank
Hungary	3. rank	8. rank	6. rank	16. rank	17. rank	14. rank
Austria	-	-	-	9. rank	23. rank	19. rank
Spain	-	-	-	20. rank	26. rank	27. rank
Malta	-	-	30. rank	-	-	-

EU Commission declared the Socrates and Erasmus education programs in the field of higher education end of the 1980's. These programs aimed at higher education institutions and their students and staff in all members and candidates of EU to promote a European dimension of education and to improve its quality by encouraging co-operation between the participating countries, encourage access to education for everybody, and help people acquire recognized qualifications and skills. Moreover, the Bologna Process in 1998 (European Commission, 2000) aimed to reform countries higher education systems in order to create the European higher education area by making academic degree standards and quality assurance standards more comparable and compatible throughout Europe by 2010 for Europeans and for students and scholars from other continents. This process provides the framework and the motivation for all members of EU to adopt their courses to European structure.

The US National Science Education Standards (NSES), one of the more important reforms in science education, declared that science is for everyone and its purpose is to prepare students to be scientifically literate citizens (National Research Council, 1996). NSES presented content standards related to students' understanding of the global interconnectedness between science, technology, and social perspectives. The standards indicated that science education programs preparing science teachers should be able to establish that their teacher candidates (pre-service teachers) should know, understand, and be able to demonstrate their ability to teach science in a way that prepares children to make decisions and take action on contemporary science- and technology-related issues of interest to the general society. Toward this objective, science instruction should value the students' respective cultures, experiences, and circumstances in an effort to prepare them for citizenship in our global community (Pedersen, Turkmen, 2005).

The summary of reform efforts is students should be able to use scientific facts in their daily life and to achieve knowledge on the nature of scientific thinking and processes, the nature of science and technology, and science-technology-society interactions in the light of constructivist perspective.

This study is a cross cultural comparative analysis involving Turkish, the Americans, and some European countries' elementary pre-service teachers. The purpose of this study is to identify elementary pre-service teachers' image of scientist, where they receive and the most frequent way they learn about scientist, and investigated the similarities and differences between groups at images and sources of images. It is crucial to see whether elementary pre-service teachers held still stereotypic views of image of scientists and determine the possible reasons of that. Meanwhile, it will contribute to literature of stereotypic images problem of scientists for last three decades.

Method

Subjects

In this study the three hundred thirty five elementary pre-service teachers, who were senior and junior, participated in the data collection procedure. All the data was collected from four different countries, 68 from US, 105 from Turkey, and 162 from Belgium and the Netherland (Table 2). However, the sub-sample in Belgium and the Netherland included students from other nine European countries who were in the school through Erasmus Exchange Program. As known Erasmus means European Community Action Scheme for the Mobility of University Students. In this program students have opportunity to study or gain work experience in a different European country while completing their degrees. While data collection process in Belgium and Netherland, 59 pre-service teachers from 9 different countries participated in this study.

Table 2. Subject of pre-service teachers participating

Countries		Female	Male	Total
Turkey (T)		75	305	105
United State (US)		47	21	68
Europe (E)	Belgium	29	12	41
	Netherland	42	20	62
	Greece	2	3	5
	Czech Republic	7	3	10
	Bulgaria	3	3	6
	Poland	2	5	7
	Latvia	3	2	5

	Hungary	2	4	6
	Austria	2	2	4
	Spain	4	5	9
	Malta	3	4	7
		221	114	335

Instrument

The study was carried out in two parts. The first part was DAST-C questionnaire. Each student was given two pieces of paper with the following instruction: Could you draw a picture of a scientist? (Try to draw one in the rectangular box below) and please explain what Scientist is Doing? The second part of regarding source of scientist image was adapted by Pedersen and Turkmen (2005) and a little changed for this study. In the second part two questions were asked, first "Where they obtain most of their information about scientist" and "The Most Frequent Way Students Study/Learn about Scientist," with four lickert scale. The instrument language was English and there was not translate to any other foreign languages for European elementary pre-service teachers because they were Erasmus mobility students and knew the English. On the other hand translation was made for Turkish elementary pre-service teachers by 3 academicians.

Data collection & analysis

The questionnaire was conducted to attempt to ascertain information about the image of scientists and source of scientist image. The questionnaire was administered by the class teacher in one of his/her lessons from 4 different countries. The teachers were asked not to give any further directions to students and no time limit was set for drawing the pictures. All teachers reported that students completed the task in 25 minutes or less.

After that, all the drawings were coded and then scored using the Barman's (1996) DAST Checklists. To address inter-rater reliability issues, all drawings were scored by two colleagues who have extensive background and experience with coding and scoring such drawings. Frequency analysis was completed on the scores of subsets examining the differences between the scores given by the researchers to the drawings. The instrument's reliability is KR-20 = .72. The validity was determined via review of drawings by author. The second part of questionnaire regarding source of scientist image was measured by ANOVA to represent descriptive analyses and

any statistical differences between groups. The reliability of the instrument was documented at .89.

The pictures were evaluated using a scoring sheet developed using the 15 standard indicators suggested in the study by Barman (1996). The drawings were coded by the author and his 2 collogues. Each drawing was rated for specific stereotypic images and additional information obtained from the student narratives by using DAST-C (Table 3). The literature says, scientists depicted as a white male, middle-aged or older, wearing a lab coat and glasses and featuring some type of facial hair (Barman, 1996-1997-1999; Bodzin, & Gehringer, 2001; Chambers 1983; Finson, 2002-2003; Finson, Beaver, & Cramond 1995; Finson, Pedersen, & Thomas, 2006; Flick, 1990; Fort & Varney 1989; Fung, 2002; Huber & Burton 1995; Moseley, & Norris, 1999; Odell, Hewitt, Bowman, & Boone, 1993; Pedersen, & Thomas, 1999; Pedersen & Turkmen, 2005; Rosenthal, 1993; Ryder, Leach, & Driver, 1999; Schibeci & Sorensen, 1983; She, 1995-1998; Song, & Kim, 1999; Symington, & Spurling, 1990; Thomas, & Pedersen, 1998; Thomas, Pedersen, & Finson, 2001; Turkmen, 2008).

This study showed that students perceived scientists who have "facial hair" (E: 45%, US: 43%, T: 48%), and indicator of "symbols of research" (E: 75%, US and T:76%) drawn laboratory equipment, including test tubes, various types of flasks, beakers and burners with flames and "symbols of knowledge" (E: 80%, US: 79%, T: 77%) drawn books, shelves or stationery, were almost same percentage. Moreover, there often is a lack of perspective in "Indications of Danger" (E: 0%, US: 1%, T: 2%) and "Mythic Stereotypes (Frankenstein creatures, etc.)" (E: 0%, US: 0%, T: 0%) and "Indications of Secrecy" (E: 0%, US: 0%, T: 1%).

Table 3. Pre-service teachers' stereotypic images of a scientist

Barman's Indicators (1996)	E	US	T
1. Scientist Wearing a Lab Coat	**69%**	**60%**	**81%**
2. Scientist Wearing Eyeglasses	63%	65%	**93%**
3. Scientist With Facial Hair	45%	43%	48%
4. Symbols of Research (instruments, lab equipment, etc.)	75%	76%	76%
5. Symbols of Knowledge (books, clip boards, pens in pockets, etc.)	80%	79%	77%
6. Technology (e.g. telephone, TV, computers, etc.)	54%	**71%**	49%
7. Relevant Captions (formula, classification, "eureka", etc.)	**75%**	**66%**	**51%**
8. Male Gender	59%	60%	**74%**
9. Caucasian(s)	100%	**70%**	100%

10. Scientist in Middle Aged/Elderly	68%	65%	**88%**
11. Scientist has Mythic Stereotypes (Frankenstein creatures, etc.)	0	0	0
12. Indications of Secrecy (Warnings of "private," etc.)	0	0	1%
13. Scientist is Working in Lab	**74%**	**61%**	**88%**
14. Indications of Danger	0	1%	2%
15. Open comments related to dress items, neckties, hair style, smile/frown, etc. • Depicted scientists wearing regular clothing (e.g., blue jeans, T-shirt) • Drew the scientist with a smile	**31%** 60%	**40%** 55%	**15%** **32%**
*E: European, US: American, T: Turkish pre-service teachers			

Although there groups of Pre-service teachers have different cultural lives, they have almost same stereotypic images of a scientist in their minds for all indicators, except "Mythic Stereotypes," "Indications of Secrecy and Danger", because frequencies showed that all indicators for three groups are over %50 percentage.

Ethnic minority representation was practically nonexistent in European countries and Turkey because of "Caucasian(s)" indicator. Caucasian refers to people native to the Caucasus but it has become interchangeable with any number of "white" populations. All scientists are Caucasian, except Americans depicted 30% of their drawings include black and/or Asian scientists. One possible explanation for Turkish pre-service teachers is all Turks are Caucasian and they probably have never seen any black or Hispanic or Asian scientists in their schools or social lives, but it is very interesting for European pre-service teachers (Table 3).

On the other hand, American and European pre-service teachers frequency results are very close; and less perspective on "scientist wearing eye glasses" (E: 63%, US: 65%, T: 93%), "male gender" (E: 59%, US: 60%, T: 74%), "Scientist in Middle Aged/Elderly" (E: 68%, US: 65%, T: 88%); and more perspective on "Drew the scientist with a smile" (E: 60%, US: 55%, T: 32%), than Turkish pre-service teachers'.

Meanwhile all three groups have different percentage of DAST indicators on "Scientist Wearing a Lab Coat" (E: 69%, US: 60%, T: 81%) and opposite indicator "wearing regular clothes", suits, blue jeans, T-shirt, (E: 31%, US: 40%, T: 15); "Relevant Captions (formula, classification, "eureka", etc.)" (E: 75%, US: 66%, T: 51%), "Scientist is Working in Lab" (E: 74%, US: 61%, T: 88%).

The interesting result was that mostly all image of scientists in three groups of pre-service teachers' minds works in a laboratory and stands behind or by the side of a table but very few are outside. Moreover, scientist stands alone in an environment (generally laboratory) surrounded by objects of research or knowledge and barely included other people. Another interesting result was noted that both pre-service teachers pay close attention scientists' contributions to the well-known of mankind, such as, Albert Einstein, Isaac Newton , Graham Bell, and Thomas Edison as a male scientists (figure 1).

Figure 1. Pre-service teachers' drawings

In the second part of questionnaire, pre-service teachers answered based on items listed on the instrument "Where they obtain most of their information about scientist". All three groups think all sources of image of scientist are important and their scores are over 2 point. In three groups, European pre-service teachers have highest mean scores; Turkish pre-service teachers have lowest mean scores for media (E: 2,8389, US: 2,7143, T: 2,2857), friends (E:2,9815, US: 2,8868, T: 2,4307) and parents (E: 3,0914, US: 2,9739, T: 2,4062). Oppositely Turkish pre-service teachers has highest mean score, Europeans has lowest mean score for teachers (E: 3,3272, US: 3,4529, T: 3,8519) as a source of information about Scientist.

Despite only teachers, as a source, are very important source for Turks, possible reason of that learning is strictly related to school and teachers. Like lifelong learning, inquiry and social learning theories are internalization processes in Turkish education system. The proof is that as mentioned above the international competitions, like PISA TIMMS. Oppositely, the American European pre-service teachers think media, friends, and parent are very important as much as teachers (Table 4).

Table 4. Descriptive analyzes of where pre-service teachers receive information about scientist: Individuals

		N	Min.	Max.	M	sd
European pre-service teachers	media	162	1,00	4,00	2,8389	,86333
	friends				2,9815	,80736
	parents				3,0914	,82307
	teachers				3,3272	,78677
American pre-service teachers	media	68	1,00	4,00	2,7143	,50531
	friends				2,8868	,76393
	parents				2,9739	,40746
	teachers				3,4529	,70008
Turkish pre-service teachers	media	105	1,00	4,00	2,2857	1,05351
	friends				2,4307	1,00252
	parents				2,4062	1,02304
	teachers				3,8519	,41952

M: mean, sd: standard deviation

According to analyze of ANOVA - Post Hoc Tests (Table 5), the difference in that section between European and Turkish pre-service teacher; the Americans and Turkish pre-service teachers; were marginally significant (all P values = ,000), on the other hand there could find any statistical difference between the American and European pre-service teachers (P values = ,063 for media, ,076 for friends, ,082 for parents, ,061 for teachers)

Table 5. Multiple comparisons of groups about receiving information about scientist dependent variable: Score

	Groups		Mean difference	Std. error	Sig.
Media	1	2	,1246	1,054	,063
		3	,6032	,986	**,000**

	2	1	-,1246	1,054	,063
		3	-,1714	,675	**,000**
	3	1	-,6032	,986	**,000**
		2	,1714	,675	**,000**
Friends	1	2	,0947	1,132	,076
		3	,5508	,825	**,000**
	2	1	-,0947	1,132	,076
		3	,4521	,572	**,000**
	3	1	-,5508	,825	**,000**
		2	-,4521	,572	**,000**
Parents	1	2	,1175	,667	,082
		3	,8552	1,123	**,000**
	2	1	-,1175	,667	,082
		3	,5277	,885	**,000**
	3	1	-,8552	1,123	**,000**
		2	-,5277	,885	**,000**
Teachers	1	2	-,1257	,467	,061
		3	-,5247	,849	**,000**
	2	1	,1257	,467	,061
		3	-,3990	,721	**,000**
	3	1	,5247	,849	**,000**
		2	,3990	,721	**,000**

p > 0.05, Group1: European pre-service teachers, Group2: American pre-service teachers, Group3: Turkish pre-service teachers

The analyzing of "The Most Frequent Way Students Study/Learn About Scientist" showed that Turkish pre-service teachers have lowest mean scores for all questions. All groups of pre-service teachers' images of scientists were influenced to a considerable degree by teachers (E: 2,90; US: 2,73; T: 2.48), the content of science textbooks (E: 2.88, US: 2.78, T: 2.69) and books (E: 2.87, US: 3.12, T: 2.51), this study illustrated the possible impact of the curriculum. However, the statements of "Students write papers about scientist" (M: 1.88) and "Students participate in field trips related to scientists" (M: 1.23) were seen as the least likely manner (never) and "Students read about scientists in an article or journal," and "Students complete projects on scientists" were ranked in "sometimes" manner by which Turkish pre-service teachers learn about scientists. On the contrary, The American and European elementary pre-service teachers do not have the least likely manner (never) and these, question 2 and 6, are thought in "frequently" manner (Table 6).

Table 6. Descriptive analyzes of the most frequent way students study/Learn about scientist

Questions	E		US		T	
	M	sd	M	sd	M	sd
1. A teacher talks about scientists in class.	2,8951	,90963	2,7289	,83936	2,4802	,96472
2. Students read about scientists in an article or journal.	2,8803	,88463	2,7822	,78821	2,2001	1,1042
3. Students write papers about scientist.	2,9512	1,0196	3,0119	,69962	1,8848	,79022
4. Students read about scientists in books (other than textbooks).	2,8724	,80443	3,1246	,62621	2,5143	,90772
5. Students read about scientists in textbooks.	2,8835	,89063	2,7828	,72178	2,6933	,97681
6. Students complete projects on scientists.	2,9834	1,09263	3,4333	,59761	2,0544	,84672
7. Students participate in field trips related to scientists.	2,3937	,90963	2,4543	1,0832	1,2341	,67812
Average of all questions	2,837		2,9315		2,0968	

It was found that the difference is judged to be no statistically significant difference between European and Turkish pre-service teachers in question 4 (0,18 > 0,05), question 5 (0,111 > 0,05) but in question 1 (,038 < 0,05), question 2 (,044<0,05), question 3 (,013<0,05), question 6 (,002<0,05) and question 7 (,006<0,05) we see statistically significant difference.

There is no statistically significant difference between the American and Turkish pre-service teachers in only question 5 (0,388 > 0,05) but in all other questions there are.

On the other hand, significant differences between Europeans and the Americans was just found only in two question 4 (0,03 < 0,05) and question 6 (0,008< 0,05) and the Americans has higher mean scores than Europeans.

American pre-service teachers read more books about scientists and do more projects about them than Europeans. In the present study, 107 biology projects participating in secondary education students to the Bursa Region Coordinator ship of TUBITAK-BİDEB were evaluated. The distribution of the projects applying to competition between 2009 and 2012 by years is given in the Table 2.

Table 7. Multiple comparisons of groups about "The most frequent way students study/Learn about scientist"

Dependent variable: SCORE

	Groups		Mean difference	Std. error	Sig.
1. A teacher talks about scientists in class	1	2	,1662	,332	,123
		3	,4149	,566	**,038**
	2	1	-,1662	,332	,123
		3	,2487	,639	**,048**
	3	1	-,4149	,566	**,038**
		2	-,2487	,639	**,048**
2. Students read about scientists in an article or journal	1	2	,0981	,484	,621
		3	,6802	,839	**,044**
	2	1	-,0981	,484	,621
		3	,5821	,439	**,036**
	3	1	-,6802	,839	**,044**
		2	-,5821	,439	**,036**
3. Students write papers about scientist	1	2	-,0607	,284	,217
		3	1,0664	,997	**,013**
	2	1	,0607	,284	,217
		3	1,1271	1,132	**,001**
	3	1	-1,0664	,997	**,013**
		2	-1,1271	1,132	**,001**
4. Students read about scientists in books (other than textbooks).	1	2	-,2522	,583	**,03**
		3	,3581	,649	,18
	2	1	,2522	,583	**,03**
		3	,6103	,887	**,047**
	3	1	-,3581	,649	,18
		2	-,6103	,887	**,047**
5. Students read about scientists in textbooks	1	2	,1007	1,332	,137
		3	,1902	1,032	,111
	2	1	-,1007	1,332	,137
		3	,1895	1,002	,388
	3	1	-,1902	1,032	,111
		2	-,1895	1,002	,388
6. Students complete projects on scientists.	1	2	-,4499	,832	**,008**
		3	,9290	,982	**,002**
	2	1	,4499	,832	**,008**
		3	1,3789	,732	**,003**

	3	1	-,9290	,982	**,002**
		2	-1,3789	,732	**,003**
7. Students participate in field trips related to scientists.	1	2	-,0607	,984	,067
		3	1,1596	,792	**,006**
	2	1	,0607	,984	,067
		3	1,2202	,532	**,021**
	3	1	-1,1596	,792	**,006**
		2	-1,2202	,532	**,021**

Conclusion

All elementary pre-service teachers in this study held similar stereotypic images of scientists. The view of Turkish pre-service teachers is less focused on them than Europeans' and the Americans. Eventually, stereotypical images of the scientist are a slightly lesser than revealed in previous studies but stereotypes of scientists are widely persistent even among elementary preservice teachers. First, stereotypical perceptions are persistent. Next, the stereotypical image has been revealed time and again in student and adult drawings. The research indicates that this image perception extends across age groups, across grade levels, and across decades, like in literature. The stereotype of scientists being elderly, male, Caucasian, and working in lab has largely endured. Similarly, most of them are chemists (Barman, 1997; 1999; Bodzin & Gehringer, 2001; Chambers, 1983; Chiang, & Guo, 1996; Finson, 2002; 2003; Finson, Beaver & Crammond, 1995; Finson, Pedersen & Thomas, 2006; Flick, 1990; Fort & Varney 1989; Fung, 2002; Huber & Burton, 1995; Jane, Fleer, & Gipps, 2007; Koren & Bar, 2009; Monhardt, 2003; Moseley & Norris, 1999; Newton & Newton, 1992; Schibeci & Sorenson, 1983; She, 1995; 1998; Song & Kim, 1999; Symington & Spurling, 1990; Türkmen, 2008). It is one of main responsibility for teachers, science educators, and curriculum developers to know what students' perception are about science. Many researchers and educators believed that if students have less stereotypical the image of scientists, they will more probable have positive attitudes toward science and subsequently consider to select a job in the sciences (Bodzin & Gehringer, 2001; Flick, 1990; Matkins, 1996; Rosenthal 1993). Hence, information about students' perceptions of scientist is vital tool to evaluate science curriculum.

Cultures impact not only science but also the perceptions of scientists. The difference is prevailing culture of a country allows negative stereotypes to deter a child's learning of science. Parents, counselors, principals, teachers, friends, and media

influence students' attitudes toward science. Epstein (1997) discussed how children learn and grow through three overlapping factors, family, school, and community. Public attitude affects people's attitudes toward science implicitly or explicitly. Parental / familial involvement in school has been found to improve facets of children's education such as academic achievement (Van Voorhis, 2001).

One conclusion they drew was that pre-service elementary teachers' images of scientists and attitudes toward science may be affected by the way science is taught in their teacher education programs. The most recent primary level of science curriculum programs includes activities to engage students in the manner of constructivist approach for the US, European countries and Turkey. Literature says the constructivist approach to teaching impacts on students' minds and attitudes in a positive manner. After declaration of EU Lifelong Learning process and US National Science Education Standards, all learning activity undertaken throughout life, with the aim of improving knowledge, skills and competences within a personal, civic, social and/or employment-related perspective, the US, many European countries and Turkey take it as a fundamental goal of education policies and a way to achieve socio-economic development and a tool to promote the information and knowledge based society. So far, partly the American and European elementary pre-service teachers have succeeded in seeing parent, friends, and media as source of scientific image despite they have some stereotypic images of scientists. However, Turkish elementary pre-service teachers still have problem about that, because Turkish reforms have not enough influenced to Turkish elementary pre-service teachers' minds so far. The researchers concluded that one could not assume pre-service teachers come to science education courses with a complete understanding of what a scientist is (Moseley & Norris, 1999).

Limitations

While the DAST is simple method and only provided us with a one dimensional snapshot of students' mental representations about scientists and do not necessarily reflects what students believe. Hence, it would be useful to include interviews for deeper understanding of students' constructs after the drawing activity.

It is possible that with larger sample sizes a clearer picture of impact may have emerged. The results would indicate potential for additional research examining in-service teachers' perception and/or academicians' perception of scientist, and the

relationship between academicians' perceptions and pre-service teachers of scientists. Further research is encouraged that would include larger sample sizes.

Suggestions

Studies have shown that students' views of scientists are established and developed early and significant experiences, they are often static (or resistant to change) (Finson, Pedersen, & Thomas, 2006). To get rid of stereotypic images of scientists,

- If students have more positive attitudes toward a subject when the subject they are learning seems directly relevant to their lives (Zacharia & Calabrese Barton 2004). Thus teachers and academicians should integrate EU Lifelong Learning process in minds and prepare students to be scientifically literate citizens in the light of constructivist perspective.
- Teachers and curriculum developers need to be encouraged to use the special features in science textbooks that highlight science careers, depict scientists as everyday people.
- Teachers should apply other type of sources, like scientific journals, magazines, newspapers, in their lessons.
- Teachers should get students meet with scientists. Scientists can come to the university or primary classroom and students can ask them to talk about their lives not just their science. Even, they can get helpful from students' parents having a science background and from university academicians.
- The participation in field trips related to scientists' activities should be integrated in science curriculum and students and teachers should be forced to do that.
- Universities need to make more cooperation with modern countries universities. Closer cooperation in universities will help all pre-service teachers and the whole society more broadly than they do now.
- National and local media should be careful the misinterpretation of science concepts in their broadcasting. There should be one of responsibilities is to educate people.

References

Barman, C.R. (1996). How Do Students Really View Science and Scientist? *Science and Children*, 34(1), 30-33.

Barman, C.R. (1997). Students' views of scientists and science: Results from a national study. *Science and Children, 35*, 18-35.

Barman, C.R. (1999). Students' views about scientists and school science: Engaging K-8 teachers in a national study. *Journal of Science Teacher Education*,*10*(1), 43-54.

Bodzin, A., & Gehringer, M. (2001). Can meeting actual scientists change students' perceptions of scientists? *Science and Children*, *39*(1), 36-41.

Chambers, D.W. (1983). Stereotypic images of the scientist: The Draw-Scientist Test. Science Education, *67*(2), 255-265.

Chiang, CL., & Guo, CJ. (1996). A Study of the Image of Scientist for Elementary School Children. Paper Presented Annual Meeting of the National Association for Research in Science Teaching, MO, 1996. Retrieved January 22, 2008, fromhttp://www.eric.ed.gov/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?_nfpb=true&_&ERICExtSearch_SearchValue_0=ED399148&ERICExtSearch_SearchType_0=no&accno=ED399148

European Commission. (2000). Bologna Declaration on the European Space for Higher Education in 1999. Retrieved March, 12, 2009, fromhttp://ec.europa.eu/education/policies/educ/bologna/bologna.pdf

Finson, K.D. (2002) Drawing a scientist: what we do and do not know after fifty years of drawings. *School Science and Mathematics*, *102*, 335-346.

Finson, K.D. (2003). Applicability of the DAST-C to the images of scientists drawn by students of different racial groups. *Journal of Elementary Science Education*, *15*(1), 15- 26.

Finson, K.D., Beaver, J.B., & Crammond, R.L. (1995). Development of a field-test checklist for the draw-a scientist test. *School Science and Mathematics*,*95*(4), 195-205.

Finson, K.D., Pedersen, J., & Thomas, J. (2006). Comparing Science Teaching Styles to Students' Perceptions of Scientists. *School Science and Mathematics*, *106*(1), 8-15

Flick, L. (1990). Scientist in residence program improving children's image of science and scientists. *School Science and Mathematics*, *90*, 205-214.

Fort, D.C., & Varney H.L. (1989). How students see scientists: Mostly male, mostly white, and mostly benevolent. *Science and Children*, *26*, 8–13.

Fung, Y.H. (2002). A Comparative Study of Primary and Secondary School Students' Images of Scientists. *Research in Science & Technological Education*, *20*(2), 199- 213.

Huber, R.A., & Burton, C.M. (1995). What the students think scientists look like?*School Science and Mathematics*, *95*, 371-376.

Jane, B., Fleer, M., & Gipps, J (2007). Changing children's views of science and scientists through school-based teaching. *Asia-Pacific Forum on Science Learning and Teaching*, *8*(1), Article 11.

Koren, P & Bar, V. (2009). Pupils' Image of 'the Scientist' among Two Communities in Israel: A comparative study. *International Journal of Science Education,* 2009, 1–25.

Matkins, J.J. (1996). *Customizing the Draw-a-Scientist Test to analyze the effect that teachers have on their students' perceptions and attitudes toward science*. Paper presented at the Association for the Education of Teachers of Science Conference, 1996. Retrieved June 10, 2006, fromhttp://www.ed.psu.edu/CI/Journals/96pap44.htm.

Mead, M., & Metraux, R. (1957). The image of the scientist among high school students: a pilot study. *Science*, *126*, 384-390.

Monhardt, R.M. (2003). The image of the scientist through the eyes of Navajo children. *Journal of American Indian Education*, *42*(3), 25-39.

Moseley, C., & Norris, D. (1999). Pre-service teachers' views of scientists. *Science and Children*, *37*, 50-53.

Newton, DP. & Newton, LD. (1992). Young children's perceptions of science and the scientist. *International Journal of Science Education*, *14*(3), 331 – 348.

Oakes, J. (1990). Opportunities, achievement, and choice: Women and minority students in science and mathematics. In C.B. Cazden (Ed.), *Review of Research in Education*, Washington, DC: American Educational Research Association.

Odell, M.R.I., Hewitt, P., Bowman, J., & Boone, W.J. (1993). *Stereotypical images of scientists: A cross-age study*. Paper presented at the 41st Annual National Meeting of the National Science Teachers Association, Kansas City, MO.

Parsons, E. C. (1997). Black high school females' images of the scientist: Expression of culture. *Journal of Research in Science Teaching*, *7*, 745-768.

Pedersen, J.E., & Thomas, J. (1999). Draw-A-Science-Teacher Checklist: Children's Perceptions of Teaching Science. A paper presented at the National Association for Research in Science Teaching Conference, Boston.

Pedersen, J., & Turkmen, H. (2005). Pre-service Teachers' Knowledge and Perceptions of Social Issues. *STS Today*, *17*(2), 2-12.

Raty, H., & Snellman, L. (1997). Children's images of an intelligent person. *Journal of Social Behavior and Personality*, *12*, 773-784.

Rosenthal, D. B. (1993) Images of scientists: A comparison of biology and liberal studies majors. *School Science and Mathematics*, *93*, 212-216.

Rubin, E., & Cohen, A. (2003). The images of scientists and science among Hebrew and Arabic-speaking pre-service teachers in Israel. *International Journal of Science Education*, *25*(7), 821-846

Ryder, J., Leach, J., & Driver, R. (1999). Undergraduate science students' images of science. *Journal of Research in Science Teaching*, *36*(2), 201-219.

Schibeci, R. A., & Sorenson, I. (1983). Elementary school children's perceptions of scientists. *School Science and Mathematics*, *83*, 14-19.

She, H. (1995). Elementary and middle school students' image of science and scientists related to current science textbooks in Taiwan. *Journal of Science Education and Technology*, *4*, 283-294.

She, H. (1998) Gender and grade level differences in Taiwan students' stereotypes of science and scientists, *Research in Science & Technological Education*,*16*(2), 125–135.

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

Symington, D. & Spurling, H. (1990). The Draw-a-Scientist Test: Interpreting the data. *Research in Science and Technological Education*, *8*, 75-77.

Thomas, MD., Henley, TB., & Snell, CM. (2006). The draw a scientist test: a different population and a somewhat different story. *College Student Journal*. Retrieved January 22, 2009, fromhttp://findarticles.com/p/articles/mi_m0FCR/is_1_40/ai_n26844267/

Thomas, J. & Pedersen, J.E. (1998). Draw-A-Science-Teacher-Test: Pre-service Elementary Teachers Perceptions of Classroom Experiences. A paper presented at the National Association of Researchers in Science Teaching international meeting, San Diego: California.

Thomas, J. A., Pedersen, J. E., & Finson, K. (2001). Validating the Draw-A-Science-Teacher-Test-Checklist (DASTT-C): Exploring mental models and teacher beliefs. *Journal of Science Teacher Education*, *12*(4), 295- 310.

Turkmen, H. (2008). Turkish Primary Students' Perceptions about Scientist and What Factors Affecting the Image of the Scientists. *Eurasia Journal of Mathematics, Science & Technology Education*, *4*(1), 55-61

Van Voorhis, F.L. (2001). Interactive science homework: An experiment in home and school-connections. *National Association of Secondary School Principals Bulletin*, *85*(627), 20-32.

Zacharia, Z., & Calabrese Barton, A. (2004). Urban middle-school students' attitudes toward a defined science. *Science Education*, *88*(2) 197-222.

Appendix

DAST-C questionnaire

1. Could you draw a picture of a scientist? (Try to draw one in the rectangular box below)

2. Please explain what Scientist is Doing?

Lickert scale: 1: Definitely disagree, 2: Disagree, 3: Agree, 4: Definitely agree

3. Question: "Where they obtain most of their information about scientist.	1	2	3	4
Media				
Friends				
Parents				
Teachers				

4. Question: The Most Frequent Way Students Study/Learn About Scientist.	1	2	3	4
A teacher talks about scientists in class.				
Students read about scientists in an article or journal.				
Students write papers about scientist.				
Students read about scientists in books (other than textbooks).				
Students read about scientists in textbooks.				
Students complete projects on scientists.				
Students participate in field trips related to scientists.				