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Investigating Gifted Middle School Students' Images about Scientists: A Cultural Similarity Perspective

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ABSTRACT: The purpose of this study is to investigate gifted middle school students' images about scientists in terms of cultural similarity. Sample of the study is 64 gifted middle school students taking courses from a formal school for gifted students. The data were collected by using Draw-a-scientist (DAST) instrument and was analysed by two researchers using Draw-a-scientist C form. The data involved two different drawings for the scientist from similar culture and the popular scientists respectively, and explanations of the drawings. When looked at the findings from cultural similarity perspective, it was seen that the findings about the drawings changed for the scientists in terms of cultural similarity with the students. They wrote mostly Einstein and Edison for the popular scientists while they gave names of Cahit Arf, Avicenna and Ali Qushji for scientists from similar culture. Also they did draw lab coat and eyeglasses more frequently for the popular scientists than those for scientists from similar culture. As another finding, they drew more number of tools for research of common scientists than those for scientists from similar culture. Finally, they drew messy, noisy, non-sterile places for the scientists from similar culture while they imagined the scientists from similar culture as lazy, ignorant inattentive and clumsy. These findings show importance of cultural similarity perception of gifted students on the scientists when they think about the scientists, this situation asks new questions about culture-dependent scientist images of gifted students to gifted science education researchers using DAST.

KEY WORDS: Images regarding scientists, Gifted students, Cultural similarity, Science education

INTRODUCTION

Studies on giftedness have a long history due to its importance for both gifted individuals and societies, noting gifted individuals form a valuable human resource. Gifted students are among a valuable and statistically uncommon human group (Mcclain and Pfeiffer, 2012), having important characteristics

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which involve being innovative, creative, intrinsically motivated to learn and academically successful (Gallagher, 2008; Koksal, 2013; Neber and Schommer-Aikins, 2002; Sternberg, 2004). Gifted students have been reported to have a high level of motivation towards learning science (Köksal, 2014), high cognitive ability (Harnishfeger and Bjorklund, 1994) and creativity (Chein, 1982).

The images by students about science and scientists is one way to investigate students' learning and understanding of science. It has been reported stereotyped images lead to badly informed ideas about science and scientists and this problem produces misunderstandings preventing effective learning of science content (de Meis et al., 1993). Moreover, de Meis et al. (1993) showed stereotyped images do not change after formal training. In the literature, images of scientists and science has been shown to be associated with both career choices in science and attitudes towards science (Buldu, 2006; Finson, Beaver and Cramond, 1995). Inappropriate images such as stereotypes might be a reason of low rates of choosing science-related careers (Finson et al., 1995). For example, She (1998) found that female students' images of scientists were related to their perceptions on career-choice, since female participants imagined science-related careers for intelligent people in their drawings and they did not see themselves as sufficiently intelligent to pursue a science-related career in their interviews. This finding shows strong link between having positive self-confidence and interest in science-related careers. As another point the students draw mostly males as scientists as they see a scientist's career just for males (Song & Kim, 1999). Moreover, Buldu (2006) argued that images of scientists might be related to attitudes towards learning science.

Perceptions and cultural similarity

Images regarding scientists and science are perceptions of scientists and science from a personal point of view. Perceptions are both impressions regarding objects and events (Finson et al., 1995) and shaped by culture (Rashidi-Ranjbar, Goudarzvand, Jahangiri, Brugger and Loetscher, 2014). Culture formally involves shared and learned meanings that are effective on perceiving, believing, acting, and evaluating the actions of individuals (Goodenough, 1963). In the literature about images of scientists, it is claimed that cultural effects are clear in shaping images of the individuals (Schibeci and Lee, 2003) and one's cultural background establishes a resource to act on these images (Erickson, 1986). Therefore, studying images of gifted students about scientists might contribute to our understandings about effect of a cultural similarity perception on images of the students about science.

Giftedness

There are various definitions of giftedness, for example, Renzulli (1978) defined giftedness as a behavior shown by interaction among above average ability, high levels of task commitment, and high levels of creativity. In another study,

Feldhussen (1986) described giftedness in terms of performance areas and potentials. He suggested that giftedness is a characteristic represented in performance regarding scientific, leadership, intellectual, creative, artistic, mechanical and physical areas by using intelligence, talents, motivation, aptitudes, expertise and creativity. These two definitions emphasize performance areas and potentials. Science is one of the performance areas regarding giftedness and it is a way of converting potential of giftedness to benefit for society

Images of scientists by gifted students

In the science education literature, students' images of scientists are well-studied (Buldu, 2006; Chambers, 1983; Huang, Huang, Min and Wei, 2014; Hillman, Bloodsworth, Tilburg, Zeeman and List, 2014; Leblebicioglu, Metin, Yardımcı and Cetin, 2011; Yontar-Toğrol, 2000). However, images of gifted students about scientists are not well studied. The limited number of the studies conducted with gifted students has showed stereotypic images of the students about scientists (Camcı-Erdoğan, 2013; Melber, 2003; Ozel and Dogan, 2013).

Camcı-Erdoğan (2013) determined that gifted, middle school students saw scientists as a 30-40-year-old male person with lab coat, eyeglasses, mustache or beard and untidy clothes. Ozel and Dogan (2013) found similar images. According to Ozel and Dogan (2013), gifted 4th and 5th grade students saw scientists as a bald male with facial hair, lab coat and eyeglasses who was investigating something or conducting experiments. Melber (2003) highlighted ten stereotypic images of gifted 4th and 5th grade students, for example: lab coat, eyeglasses, facial hair, male, and unkempt appearance. These studies assumed that stereotypical images of gifted students were culture-free. However, as in the definition of giftedness (Sternberg and Grigorenko, 2004), images of scientists are also shaped by culture. Yu (2012) explained that culture shapes different perceptual habits and representational tendencies of individuals. Yu claimed that a child forms a mental template by interacting within a specific culture and with its members and gave as an example that American children associate yellow with a school bus. Therefore, studying images of scientists by gifted students from a cultural perspective has an importance for understanding the relationship between images, science-related career choices and affective characteristics regarding the learning of science. Therefore, the purpose of this study was to investigate gifted middle school students' images about scientists from a cultural similarity perspective.

METHODOLOGY

In this study, a cross-sectional descriptive research method was used. The data was collected by Draw-a-scientist (DAST) instrument (Chambers, 1983; Finson et al., 1995). For determining images of the students about common scientists and scientists from a similar culture, the students were asked to draw a common

scientist and to explain their drawing. Then students were asked to draw another picture about a scientist from a similar culture and to explain their drawings.

Before the main analysis, two independent researchers conducted a preliminary analysis separately on the drawings of 20 students and the agreement between them was found as .70 ($p<.05$) by Cramer's V correlation analysis. The actual data was analyzed by using Draw-a-scientist checklist (DAST-C). During analysis, every item in the checklist was transformed to a "Present" or "Absent" dualistic mode. In addition, important incidents were determined by comparing differences in the drawings. Findings of the study are represented by frequencies of elements in drawings and image examples.

Participants

In this research, 64 gifted Turkish middle school students (Female=37, Male=25, Missing=2) were involved. They were 10-14 years old and in the fifth grade (n=27), sixth grade (n=9) and seventh grade (n=25). The selection of the students was by using the Wechsler Intelligence Scale for Children-Revised (WISC-R) scores (130 or more), special academic test scores, and teacher or parent recommendation. These students were enrolled in a gifted education program after formal school time. The program was conducted by a center for gifted students (Science and Art Center). The center was supported and administered by the Ministry of Education, for example the teachers of the center were selected by the Ministry.

FINDINGS

The findings of the study highlighted differences in student images between common scientists and scientists from a similar culture. The students gave popular examples for names of common scientists, whereas they gave specific names of the scientists from their similar culture. Names of the scientists and frequency mentioned are represented in table 1.

As seen in table 1, students noted 34 names for common scientists and 24 names for scientists from a similar culture, with 7 names reported for both groups of scientists. It should be noted, these students gave names of some popular individuals, such as Steve Jobs and Martin Luther, as common scientists. Also they gave the names of Ataturk (Founder of Modern Turkish Republic), Hezârfen Ahmed Çelebi (Turkish aviator), Mimar Sinan (Turkish architect), Ahmed Muhiddin Piri (Turkish admiral), Pir Sultan Abdal (Turkish poet) and Aqq-Shams'ūd-Dīn (Turkish sufi) as scientists associated with their culture.

Students' drawings

Students' drawings were analyzed using checklists. The content of the drawings was grouped under the 7 categories of the checklist (see Tables 2-4).

Table 1 Names of the Scientists Written by the Students and their Frequencies

Common Scientists	f	Scientists from Similar Culture	f
Einstein	60	*Cahit Arf**	32
Edison	40	Ali Qushji	31
Graham Bell	29	*Avicenna**	31
Madam Curie	26	Gazi Yasargil	15
Tesla	24	*Avennasar**	13
Newton	19	Atatürk	12
Galileo	12	Hezârfen Ahmed Çelebi	11
Dalton	10	Al-Jazari	10
*Avicenna**	*9*	Al-Khwārizmī*	9
*Cahit Arf**	*9*	*Al-Biruni**	7
Pasteur	7	*Omar Khayyam**	6
Pisagor	6	Mehmet Oz	5
Al-Khwārizmī*	*5*	Mimar Sinan	3
*Avennasar**	*5*	Aydın Sayılı	3
Stephen Hawking	4	Jābir ibn Hayyān	2
Bohr	3	Canan Karatay	2
Rutherford	3	Takiyuddin	2
Steve Jobs	3	Ahmed Muhiddin Piri (Piri Reis)	1
Leonardo Da Vinci	3	Pir Sultan Abdal	1
*Omar Khayyam**	*2*	Selman Akbulut	1
Volt	2	Aqq-Shams'ūd-Dīn	1
*Al-Biruni**	*2*	Neva Ciftcioğlu	1
Aristotle	*2*	Oktay Sinanoglu	1
*Ulugh Beg**	*1*	*Ulugh Beg**	1
Martin Luther	1		
Gauss	1		
Ohm	1		
Thomson	1		
Democritus	1		
J.J. Thomson	1		
Marconi	1		
Henri Becquerel	1		
Magellan	1		
Pascal	1		

*refers to common names for both of the groups of drawings

Table 2 Findings of the Content (Categories I, II and III) of Drawings about Scientists associated with Common Scientists and Those from Similar Culture

	Common Scientists	f		Scientists from Similar Culture	f
Category-I	Lab coat	7	Category-I	Lab coat	2
	Eyeglasses	11		Eyeglasses	6
	Beards	1		Beards	0
	Mustaches	2		Mustaches	1
	Whiskers	0		Whiskers	0
Category-II	Male Scientists	36	Category-II	Male Scientists	32
	Female Scientists	5		Female Scientists	3
	Neuter Gender	23		Neuter Gender	29
	Old or Middle-age Scientists	0		Old or Middle-age Scientists	0
Category-III	Working Indoor	22	Category-III	Working Indoor	18
	Working Outdoors	4		Working Outdoors	10
	Independence of Working Place	38		Independence of Working Place	36

The students drew more lab coats and eyeglasses for common scientists than those for scientists from a similar culture (Category I). In addition, they drew a greater number of outdoor working places for scientists from a similar culture than those for common scientists (Category-III). Another important finding, the students drew predominately male and neuter gender scientists for both of the scientist groups (Category-II). Figure 1 represents a common male scientist with a lab coat and eyeglasses.

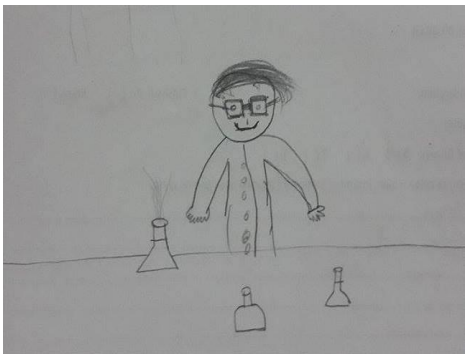

Figure 1 Common male scientist with a lab coat and eye glasses

Table 3 show findings from drawings of common scientists and scientists from a similar culture, related to lab. Equipment.

Table 3 Findings on Drawings Regarding the Lab Equipment Contents (Category-IV) of the Drawings

	Common Scientists	f		Scientists from Similar Culture	f
Category-IV	*Volumetric Flask**	22	Category-IV	*Volumetric Flask**	12
	*Test Tube**	19		*Test Tube**	13
	*Test-tube Rack**	11		*Test-tube Rack**	5
	*Bench **	43		*Bench**	24
	*Beaker**	12		*Beaker**	5
	*Solution**	23		*Solution**	12
	*Erlenmeyer Flask**	17		*Erlenmeyer Flask**	10
	Mass	1		Magnifying Lens	1
	*Gas Oven**	14		*Gas Oven**	3
	*Washbasin**	2		*Washbasin**	2
	*Glass Junction Pipe**	*5*		*Glass Junction Pipe**	3
	*Microscope**	7		*Microscope**	2
	Ampermeter	1		Thermometer	1
	Balance	3		Calliper	1
	Dynamometer	1		Dropper	1
	Voltmeter	1		Surgery Chair	1
	*Tripod**	1		*Tripod**	2
	*Stand**	5		*Stand**	1
	Chamber for Tools	4		Surgery Table	1
	*Lab Mask**	1		*Lab Mask**	1
	Refrigerator	1		Defibrillator	1
	Graduated Cylinder	5		Trash Bin	1
	*Funnel**	1		*Funnel**	1
	Fractional Distillation Funnel	1		Guinea Pig	1
	*Slide**	1		*Slide**	1
	*Lamella**	1		*Lamella**	1
	Fume Cupboard	1			
	Fire Extinguisher	1			
	Glass Prism	1			
	Wrench	1			
	Screw	1			
	Hammer	1			

*refers to common equipment for both of the groups of drawings

According to table 3, the students drew more equipment for common scientists than for scientists from a similar culture. In addition, their pictures

included 17 types of equipment for both groups. However, the differences in frequencies of this same equipment in the two different drawings were clear. They drew these common types of equipment more frequently in their common scientist drawings than those for the scientists from a similar culture. As an example, figure 2 represents a common scientist with lab equipment.

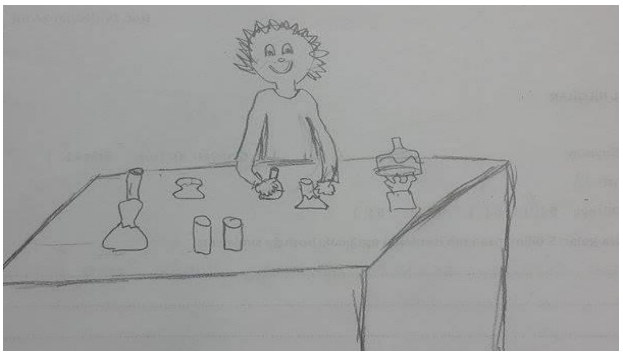

Figure 2 Common scientist with different lab equipment

Findings from drawings representing Category-V Category-VI Category-VII and Category-VIII are presented in table 4.

As seen in table 4, the students drew more books, blackboards, worktables, pencils and bookcases in their drawings for the scientists from a similar culture (Category-V). Figure 3 represents an example of the workspace of scientists from a similar culture.

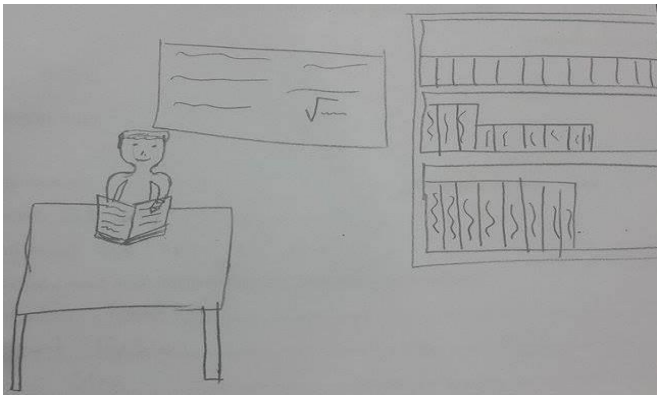

Figure 3 Workspace of scientists from a similar culture

In addition, only three different items were included in their drawing for both groups of scientists (Category-V). For common scientists, students included calculators, dusters and erasers and folders, pin boards and scissors for scientists from a similar culture.

Table 4 The Drawings' Frequencies Regarding Categories V=VIII

	Common Scientists	f		Scientists from Similar Culture	f
Category-V	*Note-book**	7	Category-V	*Note-book**	4
	*Books**	7		*Books**	11
	*Blackboard**	3		*Blackboard**	6
	*Work Table**	8		*Work Table**	10
	*Pencil**	5		*Pencil**	8
	*Bookcase**	4		*Bookcase**	5
	*Notes**	3		*Notes**	2
	*Table Lamb**	3		*Table Lamb**	1
	Calculator	1		Folders	1
	Duster	1		Pinboard	1
	Eraser	1		Scissors	1
Category-VI	*Mathematical formulas**	1	Category-VI	*Mathematical formulas**	4
	Chemical mixture	1		Flying	2
	"Yuppi"	1		Old writings	1
	Apple (Newton)	1		Tree (Newton)	1
Category-VII	*Computer**	4	Category-VII	*Computer**	3
	*Telephone**	3		*Telephone**	1
	Headphone	2		Automated comb	1
	Clock	1		Rocket	1
	Particle Accelerator	1		Control Panel	1
	Space Shuttle	1		Telescope	4
	Incubator	1		Wings	1
	Teleportation machine	1		Robot	1
	Bulb (invention)	2		Radio	1
	Automobile (invention)	1		Television	1
				Refrigerator	1
Category-VIII	Indicators of Danger	1	Category-VIII	Indicators of Danger	0
	Presence of Light Bulbs	0		Presence of Light Bulbs	3
	Mystique Symbols	0		Mystique Symbols	0
	Indicators of Secrecy	0		Indicators of Secrecy	0

*refers to common items for both of the groups of drawings

In terms of Category –VI, they drew mathematical formulas in their drawings for both of the groups of scientists but a higher frequency for the drawings of scientists in a similar culture. In Category-VII, they gave a varied number of examples for technological equipment in drawings for both of the groups of scientists. They drew two common items in considerable different frequencies across the groups of drawings about the scientists. Their drawings about common scientists involved a higher frequency of computers and telephones. In category- VIII, just two of the items (indicators of danger and light

bulbs) differed across the groups of the drawings. In spite of these differences in the drawings, some important incidents discriminating the two different drawings were also determined. These are represented in table 5.

Table 5 Notes on Important Incidents Pictured in the Drawings

Important Incident	*f*
The scientists from similar culture make work accidents	1
The working place of scientists from a similar culture is messy, noisy and non-sterile. Also tools are broken and chemicals are spilled.	5
The scientists from a similar culture stop and smell roses	2
Limited scientific activity of the scientists from a similar culture occurs due to limited financial support.	1
Ignorant and purposeful inattentive behaviors are seen of the scientists from a similar culture	2
Sadness of scientists is seen from a similar culture	3
Lack of tools and materials are indicated as the main problem of the scientists from a similar culture	2

In table 5, it was seen that the gifted students drew messy, noisy, and non-sterile places for scientists from a similar culture and they pictured the scientists from a similar culture as lazy and clumsy. In addition, they pictured the scientists from a similar culture as sad, ignorant and inattentive.

DISCUSSION AND SUGGESTIONS

Although different studies have researched gifted students' images of scientists (Camcı-Erdogan, 2013; Ozel and Dogan, 2013), studying gifted students' images of scientists by considering a cultural similarity perception has been a focus. The results of this study demonstrate the existence of a cultural similarity effect on images of gifted students about scientists. First given names for common scientist involved popular scientists, such as Einstein, Newton, Galileo, Madame Curie, Dalton, Tesla, Avicenna and Edison. Similarly, Camcı-Erdogan (2013) collected DAST data from gifted elementary school students but the researcher first asked about the names of the scientists they remembered. Her findings highlighted that her gifted students wrote Avicenna, Einstein, Edison, Tesla and Pasteur when they considered common scientists.

As a support for this finding, Akçay (2011)'s research showed that the elementary students gave names of Newton, Aristo, Einstein, Edison, Lamark, Darwin, Arshimed, Magellan, Graham Bell, and Avicenna. However, in this

study they gave names of Cahit Arf, Ali Qushji, Avicenna, Gazi Yasargil and Avennassar for the scientists from similar culture. These findings showed that students imaged scientists differently in terms of their association with a similar or dissimilar culture. Epstein, Coates, Salinas, Sanders and Simon (1997) stated that three spheres of influence, family, school and community, affect children's images. By looking at these findings, we can add a fourth sphere of influence - popular media. Camcı-Erdogan (2013) found that popular images of gifted students about common scientists are mostly shaped by films, internet, cartoons, newspapers and biographies. One common point in results between Camcı-Erdogan's (2013) and the current study is that gifted students gave names of popular individuals such as Bill Gates and Steve Jobs, even though they were not scientists. This finding supports popular culture's effect on the images about common scientists

Actually effect of popular culture on the scientist images of gifted students is an expected situation, but giving names of not so popular scientists in a similar culture is an unexpected finding, since the names of the scientists from similar culture are not common in Turkish media and educational materials. This situation is open to research in future.

As another finding, the students' images about common scientists involved a figure depicted a male scientist wearing eyeglasses and lab coat. This image is in line with international literature (Akcay, 2011; Chambers, 1983; Korkmaz and Kavak, 2010; Fort and Varney, 1989; Schibeci, 2006). Akcay (2011) examined images of 359 K-12 non-gifted students about scientists. She also asked the students to write down the names of the scientists they remembered and she found that the students wrote only names of male scientists. Korkmaz and Kavak (2010) investigated the images of 623 non-gifted elementary school students about scientists by using the DAST instrument. Their findings showed that the majority of their participating students drew male scientists wearing a lab coat and eyeglasses. Kaya, Dogan and Öcal (2008) determined images of 6th, 7th and 8th grade students about scientists. They used DAST as data collection instrument and their findings showed that male scientists wearing a lab coat and eyeglasses were the dominant images. Similarly, Ozel and Dogan (2013) studied fourth and fifth grade gifted students' images of scientists. Their findings also support the findings from this study that students' images about common scientists involve a male scientist wearing eyeglasses and a lab coat.

This study is important due its focus on gifted Turkish students. Differences in frequencies of including a lab coat, eyeglasses and gender of the scientists across the groups of the drawings might be attributed to their image differences, associated with seeing a scientist from a cultural similarity perspective. The reason for this could be shown that cultural perception and background impact mental schemas and drawings (Gardner, 1980).

Another finding showed that the students drew similar lab. equipment involving volumetric flasks, test tubes, test-tube racks, benches, solutions and Erlenmeyer flasks. Korkmaz and Kavak (2010) investigated images of non-gifted

elementary students. Their findings support the findings of the current study in terms of existence of flasks, solutions and test tubes in high frequencies in students' drawings. One difference from Korkmaz and Kavak's (2010) findings, the gifted students, in this study, drew benches and Erlenmeyer flasks, in detail. This might be related to more support by Government to gifted education than to ordinary programs. Another important issue is that the students drew more equipment in their drawings for common scientists than those for scientists from a similar culture. Moreover, their drawings, involving the same element, also represented more equipment in drawings for common scientists than those for scientists from a similar culture. This image difference might be explained by perception regarding cultural similarity with scientists for whom the drawings are created.

When the findings were examined in terms of symbols of knowledge, the students drew books, notebooks, blackboards and worktables in high frequencies. Similarly, in Korkmaz and Kavak's (2010) study, the elementary non-gifted students drew books and blackboards. However, the current study's participants represented a greater number of symbols of knowledge in their drawings. This difference might be explained by study group difference, since Korkmaz and Kavak's (2010) study involved non-gifted elementary students while the current study involved gifted students. Also, students in this study drew the symbols of knowledge in different frequencies for the groups of scientists. For instance, they drew books, worktables, blackboards and pencils in higher frequencies for scientists from a similar culture than those for common scientists. This difference might be attributed to cultural similarity perception of the students, since de Meis et al. (1993)'s study represented drawings of students from four different countries (USA, France, Brazil, Nigeria) involved different numbers of equipment and more than 50% of the drawings of the students in Brazil, USA and Nigeria involved scientists using glassware. The percentage of scientists using glassware in the three different countries also differed across the countries. As seen in this study, frequencies of equipment used by scientists and types of equipment involved in the drawings changed in terms of cultural differences.

When drawings were examined for scientific symbols, old writings are seen, as a sign of a cultural similarity perception. The scientists involved from a similar culture included individuals such as Avicenna and Avennassar, who lived in 900-1200 AD and they were using old writing in their studies. Similarly, the "flying" symbol is popular with Hezârfen Ahmed Çelebi from Turkish culture. This also involves cultural perception about the symbol. In another set of findings for Category-VII (technology symbols), the students drew very different elements in their drawings for the two groups. Evaluation of the drawings in terms of cultural similarity is very hard. Hence, there is a need for further research on this category by using additional data collection methods. Similarly, the students' drawings did not include many examples from category-VIII, as only light bulbs differed across the groups of drawings. This finding might be associated with their near educational history involving structure of students' science labs since the majority

of the names given by the students for the scientists from a similar culture used candle or gasolier in their ages. This would be a potentially rewarding area of future research using additional data collection ways.

As a different aspect of this study, notes on the drawings showed that the students drew scientists from a similar culture as sad, ignorant, lazy, clumsy and inattentive. In addition, their image of scientists from a similar culture involved messy, noisy, and non-sterile work places. This result is interesting since the students had not met any scientists from their culture, but they nevertheless held a bad image. It is possible that the sources for this came from popular media involving films, internet, cartoons, new sufficient to make such an inference and hence additional research could be useful in seeking the sources for these bad images.

This study provides valuable evidence on the images of scientists i a cultural similarity perception by gifted students. However, the sample for this study is too limited to make stronger inferences. Furthermore, for increasing the quality of data, there is a suggested need to add interview sections about gifted students' images on scientists. Also, determining cultural perceptions of the students about science might be added to future studies to explain the images of scientists in more detail.

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