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Full Length Research Paper

The relationships between the scientist perception and scientific attitudes of science teacher candidates in Turkey: A case study

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Students draw from several experiences such as testing their ideas, developing searching skills and discovering the ways of seeking information that will be necessary throughout their life with the help of science. It is noted that the conceptions of students concerning science, the nature of science and the scientists have a positive or negative impact on the future profession selection and the achievement level of the students in that field. In this study, the scientist perception of the teacher candidates were explored in terms of cognitive conception, physical conception, source of conception, the scientists observed in the milieu and the favorite scientist variables. Furthermore, the relation between scientist perception and scientific attitude were assessed by examining the scientific attitudes of the students. In order to identify the scientist perceptions of students, the scale developed by Song and Kim (1999) and to specify their scientific attitudes the scale which was developed by Moore and Foy (1997) and translated into Turkish by the author were used. Both quantitative and qualitative methods were employed in the inquiry. The research comprised a single unit of analysis (an individual, a school, etc.) therefore a holistic single case design was used in the study. Quantitative data were gathered using descriptive survey technique. In the light of the findings of this study, several recommendations were made including the need for leading students towards activities involving the scientific methods and conceptions of the students and the ways of scientists.

Key words: Scientist image, scientific attitude, science teachers, science education.

INTRODUCTION

In science classes, it is aimed not only to allow the students memorize scientific knowledge by heart, but also to help them, insofar as possible, gain the necessary attitudes and cognitive process skills necessary to solve science problems. The students may form the basis of scientific learning by only approaching the events like scientists (Regis et al., 1996). Various learning incidences may emerge as a result of the interaction between the human beings and their needs and expectations. And this affects the aptitude and behaviors of the person. In this way, patterns of behavior towards certain objects and events are formed and the relation of the individual with the objects outside is built (Kılıç, 2002).

The students learn scientific thinking process as they learn science. Several experiences that will be necessary throughout their lives such as developing the skills of discovering the ways of obtaining knowledge, testing their ideas and searching are delivered. Dewey (1996) viewed scientific thinking and scientific method, in a sense, as the applications and strategies of science and defined these concepts as someone maintaining his/her skills at the maximum level by using the power of thinking without being restricted by any obstacles.

It's aimed with science classes to improve the scientific literacy of the students. What's meant by scientific literacy knows the nature of science, understanding the genesis of knowledge, perceiving that the knowledge in science is associated with the known facts and these knowledge may change with the emergence of new evidence, learning the fundamental concepts, theories and

hypothesis of science and distinguishing between the scientific evidence and personal view. The societies that achieved the scientific literacy may keep pace with developments more easily and lead the endeavors of innovation (YÖK/World Bank, Improvement of the National Education Project, 1997 a, b). Scientific literacy has seven dimensions (MEB, 2005);

- Nature of Science
- Key science concepts
- Scientific process skills
- Science-technology-society-environment interactions
- Scientific and technical psycho-motor skills
- Values forming the basis of science
- Interests and attitudes towards science

The views of the students towards science are affected substantially from out of school factors. To allow accurate understanding for the students of all the science related concepts, those concepts should be evaluated as a whole. Particularly, the documentaries, magazine programs, news programs and fictional programs on TVs have both positive and negative effects on the development of the students as scientifically literate (Dhingra, 2003). Furthermore, the written media such as journals and newspapers have a big impact on the building of the concepts about the nature of science (Kavak et al., 2006).

The way students view science, the nature of science and their opinions about scientists will affect their profession selection and their success in that field. Hence the scientific attitudes of students, their opinions about the nature of science and their views about scientists were frequently researched.

LITERATURE REVIEW

It can be seen that researchers frequently use “Draw a Scientist Test” (DAST) developed by Chambers (1983) to determine the student views about scientists. In a study by Rubin et al. (2003), Israeli pre-service teachers’ descriptions of scientists were sought. It was noted that the students mostly described scientists as male, physician or chemist and as working in a lab. In his study, Fung (2002) used DAST and studied how Chinese students’ views of scientists differed in terms of gender and class. According to the results of this, it can be seen that students specified scientists generally as male. In their study, Bodzin and Gehringer (2001) reported that scientists were described mostly as white, male, working in a lab and wearing glasses. To alter this common conception, scientists were invited to lectures and the students are allowed to observe them at work. Intentionally, some of the invited scientists were female. Following this study, the students are asked again to draw a scientist and it was found that the number of male, glassed and with a laboratory coat scientist pictures decreased. Song and Kim (1999) examined the views of the Korean students about scientists in terms of the scientist image shaped in their minds, the physical images, the source of the images shaped in their minds, the scientists observed around and the scientists viewed as famous. In another study, Balkı et al. (2003) directed open ended questions to primary education students. It was noted that the students defined scientists typically as individuals carrying out research. The students stated that when a person becomes a scientist, she/he will have to deal with works such as discovery, invention and being a scientist would be arduous.

There are several studies on the importance of changing the negative conceptions formed in students' minds. Because these negative opinions will affect the prospective success and attitudes of students. In his study, Türkmen (2003) reported that the attitudes of the students towards science weakened over time and this affected their success and the comprehension of scientific concepts. He stressed the necessity of organizing the school environment by considering this point.

Schibeci (2006) suggested that the views about scientists were formed stereotypically (glassed, wearing laboratory coat, etc.) and that these conceptions should be removed. Scherz and Oren (2006) implemented a program named “Investigation into Science and Techno-logy (IST)” to change the conceptions of students about science and technology. In this program, applications of science and technology in real life were covered. As a result of the applications in this study, it was noted that students developed positive attitudes towards science. In the context of the students' views about the nature of science, Kang et al. (2005) investigated the titles of the purpose of science, definition of history of science, structure of the models, the precision of the scientific theories and the origin of the scientific theories and they reported that the students were inclined to experimental studies. Varelas et al. (2005) investigated the differences and similarities when the teachers imagined themselves both as a teacher and a scientist. As a scientist; they defined themselves as individuals changing by time, not representing a uniform line, dealing with complex science subjects and leading the society. Rahm and Charbonneau (1997) employed DAST to 49 university students and graduates and attempted to collect their views about scientists. In this study, it was reported that the childhood experiences and media had a deep impact on the scientist image in the students’ minds.

Jones et al. (2000) examined the views of students about science, out of school activities, engaging science subjects and future profession selection. It was noted that male students preferred easy and paying professions. Moreover it was stated by the students that science was difficult and involves dangerous studies. In the study of Morrison et al. (in the press), it was found that the stu-

dents did not have sufficient level of knowledge about the nature of science. As a result of this study it was suggested that a number of activities explicating how scientists viewed science and what the applications of science were should be carried out. Moreover, allowing students to observe scientist at work, having conversations with them on science will add to their knowledge about science. Eijck et al. (2008) claimed that the scientific studies conducted by students will have significant effects on their ideas about science and the more number of activities implemented the more positive views students will have about science.

Smith and Erb (1986) conducted a study which concluded if students' modeled scientists this would affect their attitudes towards science and scientists. In this study, they reported that the students in the experiment group developed more positive attitudes towards science when compared to the control group. In addition, Maoz and Rishpon (1990) conducted a study to enable the primary education students to learn scientists and their studies and then to examine the attitudes gained by the students in this way. This study showed that students developed a high level of attitude and 8th graders demonstrated a higher level of attitude when compared with 11th graders. Flick (1990) inquired the development of students' conceptions of science and scientists within the frame of "scientists in primary schools program".

Over the course of one year, four scientists and a doctorate student participated in the program and made class visits. At the end of the instruction the data were gathered with DAST and the results were interpreted. When the findings were examined, it was seen that the students' perceptions of scientists developed in a positive manner. In this regard, it was claimed that maintaining a long term positive attitude in students towards science and scientists could be achieved only by developing programs with the cooperation of teachers and scientists and carrying out joint activities. Moreover, in another study by Demirbas and Yagbasan (2005), teaching methods involving the studies of scientists were employed on the primary education students and as a result of the study it was found that the students' conceptions of scientists were changed in a positive manner. Mason et al. (1991) used DAST in order to determine the scientist image in students' minds. The scientist pictures obtained were categorized with respect to certain properties and they were evaluated. Especially the female students were reported to have negative views on science classes and to be reluctant in choosing a scientific profession. In this study it was concluded that positive attitudes towards science and scientists would enhance their attitudes towards science and they would become more exited in choosing a scientific profession.

When we examine the results of this study, it can be seen that the students generally had certain descriptions about the scientists. Furthermore, the view that scientists are generally male is another issue we confronted. Hence, the results of the studies towards changing these ideas are also important. In the following part, the importance of the study will be revisited and the findings of this study will be elucidated by linking them to the results of previous studies.

THE AIM OF THE STUDY

Bringing up individuals equipped with cognitive process skills, having a scientific thinking and approaching events with this point of view is an important issue. Particularly the views of primary education students and the teachers that will educate these students about science and scientists prove important since the primary education is the first level of fostering scientific thinking skills. The teachers brought up in the faculties of science education are expected to be educated as knowing the nature of science, understanding the scientific approach and to convey this knowledge to their prospective students when they start teaching. In this paper, it was aimed to determine the views of 4th year student science teachers about scientists. For this aim, the following sub problems were addressed: For the science teacher candidates;

1. What are their views about the general qualities of scientists?
2. What are their views about the physical qualities of scientists?
3. What are the factors they are influenced while forming the scientist image?
4. Who are the persons they see around as scientists?
5. Is there any relationship between their scientific attitudes and the scientist conceptions they drew?

METHOD

The model of the research

Qualitative and quantitative methods were used in the study. For qualitative data, the students are asked to draw their ideas about scientists for certain occasions. Qualitative studies do not seek the purpose of deriving generalizations but they search for deeper and more detailed analysis of the task at hand for all possible cases. Since there is only one unit of analysis (an individual, a school etc.), a Holistic Single Case Design was used in the study (Yıldırım and Şimşek, 2008). In case studies, in the analysis of the data, construction of models can be used (Büyüköztürk et al., 2008).

The quantitative data were collected using survey technique. This method is used in the studies describing the events, objects, organizations, groups and several fields (Kaptan, 1991). This method was used since the views of teacher candidates about scientists were handled with the 5-point scale.

Study group and data collecting tools

The study consisted of total 120 student science teachers (58 male, 63 female) studying at Ahi Evran University, Faculty of Education,

Table 1. The structure of the "the images of the scientist" scale.

Items	Content	Type of answer
1	Cognitive image of the Scientist	5-point ranking scale
2	Physical image of the Scientist	Drawing a picture with respect to some titles
3	Source of Conception	Choosing among the given options
4	The scientists around us	Defining a person and giving reason
5	My adopted scientist	Giving a name and writing a reason

Table 2. The gender of the teacher candidates.

Gender	f	%
Males	58	47.9
Females	63	52.1
Total	121	100.0

Science Education Department. A literature review was carried out in order to determine the scientist conception the students form in their minds. It was noted that DAST - Draw a scientist test scale was frequently used in previous studies to reveal the students' conceptions about scientists. For this aim, it was judged that using the images of the scientist scale which was formed by revising the DAST scales would be appropriate.

The original scale was in English so it was translated into Turkish by the author. An evaluation form was developed in order to submit the scale to expert views and assess the scale in terms of language and content. During adaptation into Turkish, the scale and the evaluation form were sent to 3 science education field experts, 3 English lecturers, 2 measurement and evaluation experts, 2 program development experts and they are asked to evaluate the items in the scale. In the evaluation of the items by the experts, the ratings of the experts for each item among "Not appropriate at all", "Hardly appropriate", "Appropriate", "Very appropriate" options were considered and the items that were generally found as inappropriate were fixed (Appendix: The Images of the Scientist Scale). The structure of the "The images of the scientist" scale is shown in Table 1.

The scientific attitudes of the students were examined with this study and the conceptions of the students with a high level of scientific attitude about scientists were revealed. With this aim SAI-II Scientific Attitude Inventory-II which was developed by Moore and Foy (1997) and adapted into Turkish by Demirbaş and Yağbasan (2006a) was used. Since the adaptation of the scale was employed for primary education students, it was thought that a reliability analysis should be made before using it on university students. For this aim, the scale was implemented on 100 science teachers that are exclusive of the experiment group, and the Cronbach Alpha Reliability coefficient was found as 0.72. The Scientific attitude scale consists of total 40 items. The 40 items in the scale were structured so as to explain the feelings of the students about science, the nature of science and the working styles of scientists. The items were designed in 5-point Likert type and the answer choices were grouped as "Strongly Agree", "Agree", "Not sure", "Disagree" and "Strongly Disagree". 20 of the items were positive whereas 20 were negative. Moreover, the scale was divided into 6 subscales. 5 of the subscales were about the nature of science and the working styles of scientists; 1 subscale was about the feelings of the students about science. In the scoring of the items, positive items were scored as 5, 4, 3, 2, 1 and negative items as 1, 2, 3, 4 and 5. The highest and lowest scores possible from the attitude scale ranged between 200 - 40.

Data analysis

In the analysis of the quantitative data, the frequency distributions (f) of the answers given by the students were calculated, the arithmetic mean ($\bar{x}$) values were examined and these statistics were interpreted. The data from the questions and drawings in the qualitative part of the study were analyzed within the framework of related titles and different researchers classified the findings independent of each other. When exemplifying the answers given by the students, every student was assigned with a number and the genders of the students were indicated next to each student's expression. The grouped data then were linked with related literature.

RESEARCH FINDINGS

In the context of the study, the findings on the proposed sub problems were described below for each item. The gender of the participant teacher candidates and the type of schools they have graduated were listed in Tables 2 and 3.

The findings about the answers of teacher candidates given to the question "What do you think of the characteristics of scientists?"

The teacher candidates were asked to evaluate "their opinions about scientists" with the 5-point scale. The distribution of the answers given by the teacher candidates is shown in Table 4. When the data in Table 4 is examined, it can be seen that teacher candidates defined scientists as a general rule, as careful ($\bar{x}$ = 4.4), intelligent ($\bar{x}$ = 4.14), hardworking ($\bar{x}$ = 4.35) and creative ($\bar{x}$ = 4.20). On the contrary, for the characteristics such as being artistic ($\bar{x}$ = 2.80), or religious ($\bar{x}$ = 2.95) the student teachers either give low scores or they remained uncertain. If the total score for all items is considered, it can be said that the views of students about scientists are by large positive ($\bar{x}$ = 3.69).

The findings about the answers of teacher candidates given to the question "Which characteristics would you have if you were scientists?"

The teacher candidates are asked to answer the question "Which

Table 3. The school types the teacher candidates graduated from.

School type	f	%
Standard High School	65	53.7
Anatolian High School	18	14.9
Anatolian Teacher College	6	5.0
Super High School	28	23.1
Private High Schools	4	3.3
Total	121	100.0

Table 4. The opinions of the students about scientists.

Characteristics	N	Mean ($\bar{x}$)	Std. Deviation(S)
1. Careful	121	4.40	0.84
2. Intelligent	121	4.14	0.94
3. Hardworking	121	4.35	0.95
4. Creative	121	4.20	1.12
5. Caring	121	3.29	1.19
6. Open minded	121	4.00	1.12
7. Has an exiting personality	121	2.85	1.13
8. Artistic	121	2.80	1.16
9. Humanist	121	3.46	1.02
10. Responsible	121	4.09	1.17
11. Religious	121	2.95	1.03
12. Peaceful	121	3.76	0.95
Total	121	3.69	0.50

characteristics would you have if you were scientists?" with the 5-point scale. The distribution of the answers given by the teacher candidates is shown in Table 5.

Here, it can be seen that when the student teachers imagined themselves as scientists they attributed themselves the characteristics of being careful ($\bar{x}$ = 4.38), intelligent ($\bar{x}$ = 4.53), open minded ($\bar{x}$ = 4.22), responsible ($\bar{x}$ = 4.34) and peaceful ($\bar{x}$ = 4.61). Besides, the student teachers were uncertain about being artistic ($\bar{x}$ = 3.09). When we examine the total scores of the student teachers in terms of all characteristics, it was found that the students were positive ($\bar{x}$ = 4.19).

The findings from the drawings of teacher candidates about the physical appearances of scientists

The student teachers were asked to draw the scientist image in their minds and then the characteristics of these drawings were classified and explained as follows:

Data about the gender of the scientist drawn: The genders of the scientists drawn by the students are shown in Table 6.
When the data in Table 6 are examined, it can be seen that 100 student teachers drew male scientists whereas 21 drew female scientists. Moreover, the names of scientists drawn by male and female student teachers were examined. Since a number of previous studies inquired how male and female scientists are viewed.

Across 58 male student teachers, 57 drew male scientists and 1 drew a female scientist; and out of 63 female student teachers 43 drew male scientists and 20 drew female scientists. According to these data, it can be concluded that student teachers (male and female) mostly imagined scientists as male.

Data about the age of the scientist drawn: The age ranges of the scientists drawn by the students are shown in Table 7.
When the data in Table 7 is examined, it can be seen that the ages of the scientists drawn ranged between 31 - 40 (N = 42) and between 41 - 50 (N = 48). According to the data, the scientists drawn were neither very young nor very old.

Data about the activity of the scientist drawn: The activities carried out by the scientists drawn by the students are shown in Table 8.

When the data in Table 8 is examined, it was seen that out of all student teachers, 36.4% drew scientists as experimenting, 31.4% as thinking and 9.9% as researching. Furthermore, although with low percentages, some student teachers drew scientists as either, lecturing, inventing, resting, eating or talking.

Below is an example of scientist pictures drawn as experimenting (Figure 1).

Data about the place of the scientist draw: The places of the scientists drawn by the students are shown in Table 9.

Table 5. The characteristics of student teachers imagined if they were scientists.

Characteristics	N	Mean ($\bar{x}$)	Std. Deviation (S)
1. Careful	121	4.38	0.97
2. Intelligent	121	4.53	0.78
3. Hardworking	121	4.27	0.96
4. Creative	121	4.29	1.06
5. Caring	121	4.14	1.03
6. Open minded	121	4.22	1.06
7. Has an exciting personality	121	4.06	1.12
8. Artistic	121	3.09	1.40
9. Humanist	121	4.40	0.90
10. Responsible	121	4.34	1.03
11. Religious	121	3.95	1.18
12. Peaceful	121	4.61	0.79
Total	121	4.19	0.53

Table 6. Gender of the scientist drawn.

Gender	f	%
Male	100	82.6
Female	21	17.4
Total	121	100.0

Table 7. Age of the scientist drawn.

Age	f	%
10-20	1	0.8
21-30	16	13.2
31-40	42	34.7
41-50	48	39.7
51-60	14	11.6
Total	121	100.0

Table 8. Activity carried out by the scientist drawn.

Activity	f	%
Thinking	38	31.4
Lecturing	2	1.7
Experimenting	44	36.4
Inventing	3	2.5
Doing Injection	1	0.8
Resting	1	0.8
Observing	5	4.1
Making Chemical Weapon	4	3.3
Eating	1	0.8
Researching	12	9.9
Watching Football	1	0.8
Talking	1	0.8
Blank	8	6.6
Total	121	100.0

When the data in Table 9 are examined, it can be seen that most of the student teachers (82.6%) drew scientists in a lab. A few student teachers composed scientist pictures at home, in the nature or in a study room.

The picture below is an example of the places scientist pictures were drawn in Figure 2.

Data about the physical image of the scientist drawn: The physical images of the scientists drawn by the students are shown in Table 10. When Table 10 is examined, it can be seen that the scientist pictures drawn by the student teachers were glassed (N = 65), have a weird hair style (N = 58), in the lab with a lab coat (N = 50), bearded (N = 41) and balding (N = 18). Besides in some pictures, scientists were drawn as mustached and wearing hat.

The following are some examples of the pictures drawn by the students (Figures 3 and 4).

The findings about the factors that affected the student teachers in forming the scientist image

The data about the factors that affected the student teachers in forming the scientist image are shown in Table 11.

When the data in Table 11 is examined, it can be seen that while the students were drawing scientist images, they were affected mostly from scientist life stories (N = 61), movies (N = 21) and animation movies (N = 15). Additionally, scientific journals, museum visits, cartoons and textbooks were found to be among the factors affecting student teachers.

The findings about the answers of student teachers to the question "Who do you see around as scientist?"

The views of teachers about the question "Who Do You See around as Scientist?" are shown in Table 12.

When the data in Table 12 is examined, it can be seen that 62.8% of students told that they saw nobody around as scientist. Yet, there were answers such as my teacher (21.5%) and my friend (9.1%). The reasons why some students stated that they saw nobody around as scientists were:

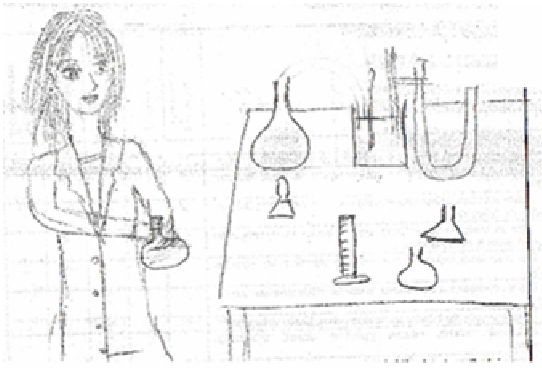

Figure 1. Here, the scientist was drawn at age 30, female and as experimenting in a laboratory (Female, 64).

Table 9. The place of the scientist drawn.

Place	f	%
In the lab	100	82.6
At home	4	3.3
In the nature	3	2.5
In the study room	3	2.5
In the classroom	1	0.8
In the hospital	1	0.8
In the Observatory	1	0.8
Blank	8	6.6
Total	121	100.0

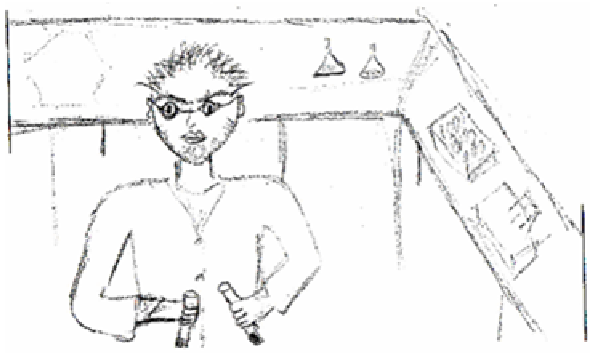

Figure 2. A male scientist at age around 40-50 is drawn as experimenting in a lab. (Female, 28).

"...there are neither appropriate settings nor ambitious people for this ... (Male, 121)"
"...There are no settings for this kind of studies in Turkey"
"...I've never seen anyone interested in research, reflecting on the problems, hardworking, intelligent and having creative ideas ..... (Female, 115)."
"... I can see no one around with a character of questioning ... (Male, 111)" "... I can't see intelligent people around ... (Male, 76)."

Table10. Physical image of the scientist drawn.

Characteristics	f*	%
With Glasses	65	53.71
Tidy	29	23.96
In a lab with a lab coat	50	41.32
Bearded	41	33.88
Has weird hair style	58	47.93
Balding	18	14.87
Mustached	4	3.30
Wearing hat	1	0.82
Smoking	4	3.30

*The characteristics here and the corresponding number values are calculated according to the pictures drawn so the numbers are different from the overall total. Because there may be more than one characteristic in a picture.

Figure 3. The scientist was drawn as male and at around 40s-50s. Has a weird hair style and with glasses (Female, 89). *In English: ""Damn it, failure again."

Figure 4. The scientist was drawn as male and at around 40s-50s. He was depicted as balding, glassed and with beard (Male, 105).

Table 11. The factors in effect during the formation of scientist image.

Affecting factors	f	%
Life stories of Scientists	61	50.4
Animation Movies	15	12.4
Movies	21	17.4
Mother and Father	3	2.5
Scientific Journals	3	2.5
Museum Visits	2	1.7
Cartoons	5	4.1
Internet	3	2.5
Textbooks	1	0.8
Teachers	1	0.8
Other	3	2.5
Blank	3	2.5
Total	121	100.0

Table 12. The views about who are seen around as scientist.

Person	f	%
Nobody	76	62.8
My teacher	26	21.5
Me	5	4.1
My friend	11	9.1
Blank	3	2.5
Total	121	100.0

"... I've never met a scientist ... (Female, 5)."

When we examine the answers of the student teachers, it can be seen that students did not view the people around them as researchers and questioners; therefore they stated they couldn't name them as scientists.
The student teachers who viewed their teachers as scientists used the following statements.

"...my teacher is committed. In my opinion, this is the most important characteristic of a scientist ... (Female, 120)".
"... our chemistry teacher: he is balding and has a weird beard ... (Male, 93)"
"...our teacher, he/she talks logically, his/her researches are wort considering ... (Male, 87)"
"...our chemistry teacher, loves researching, he/she is a patient person. I think he/she is curious and open minded ... (Female, 65)"
"... some of our lecturers at the university, because they look like a scientist ... (Female, 14)".

When we examine the answers here, it can be seen that the descriptions were according to the physical appearances of a scientist. Moreover, they have considered the people with characteristics they imagined for a scientist as scientists. The student teachers who viewed their friends as scientists used the following statements.

"... since he/she is quite and has an inquisitive character ... (male, 113)."
"… my friend inquires everything and since he/she is interested … (Female, 103)"
"... My friend wears glasses and interested in quantitative courses, I guess he/she will be a scientist in the future... (Male, 97)"

Here, it can be seen that the student teachers imagined scientists with characteristics such as having quantitative thinking and being inquisitive.
The student teachers who viewed themselves as scientists used the following statements.

"... I am curious, I like inquiring, and I am interested in scientific researches and developments. If only I studied more for OSS examination, my real ideal was to be an engineer. Then it would be easier for me to be a scientist ... (Male, 82)".
"...me, because I approach things very skeptically… (Male, 74) ".
Here the students viewed themselves as scientists because they felt themselves curious and ambitious for scientific studies.

Table 13. The views about which scientist was adopted most.

Scientist	f	%
Darwin	2	1.7
Oktay Sinanoğlu	8	6.6
Edison	18	14.9
Marie Curie	4	4.0
Bill Gates	2	2.0
Mendel	3	2.5
Archimedes	3	2.5
Einstein	32	26.4
Faraday	1	0.8
Newton	14	11.6
Mimar Sinan	2	1.7
Graham Bell	4	3.3
Thales	1	0.8
Pascal	1	0.8
Blank	26	21.48

The findings about the answers of teacher candidates given to the question "Which scientist do you adopt most?"

The views of student teachers about the question "Which scientist do you adopt most?" are shown in Table 13.

When the data in Table 13 are examined, it can be seen that the student teachers mostly adopted Einstein (N = 32), Edison (N = 18) and Newton (N = 14). In addition, few adopted Oktay Sinanoğlu (N = 8) and Mimar Sinan (N = 2) as favorite scientists. Besides, 26 students stated that they adopted no scientists.

The reasons why students adopted some scientists were stated as:

" ... Oktay Sinanoğlu, because he made some discoveries in chemistry and physics ... (Male, 3)"
" ... Edison, because electricity and bulb are vital ... (Female, 5)"
"...Marie Curie, because I read in the scientific journal "Bilim Teknik" that she had discovered radioactivity. This was very interesting … (Female, 7)"
"...Darwin, he proposed the theory of evolution. Therefore, he shed

Table 14. Scientific attitudes of students.

	N	Mean ($\bar{x}$)	Std. Deviation (S)
Male	58	133.81	11.16
Female	63	137.55	8.19
Total	121	135.76	9.87

Table 15. The group range value.

Strongly Agree	5.00-4.20
Agree	4.19-3.40
Not Sure	3.39-2.60
Disagree	2.59-1.80
Strongly Disagree	1.79-1.00

light on the genesis of human beings ... (Female, 24)"
"... Oktay Sinanoğlu, he became professor at 26 and worked on Turkish Language and Culture for years ... (Male, 26)"
"... Newton, because he discovered gravitational force through the falling apple. We may perceive it trivial now, but becoming aware of something absent and then discovering it is in fact very important ... (Female, 32)"
" ... Albert Einstein, as far as I know and read, he had a mad character ... (Male, 36)"
" ... Edison, he conducted numerous experiments until discovering electricity and in the meantime he stayed very patient ... (Male, 41)".
" ... Graham Bell, he enhanced communication by inventing telephone ... (Female, 59)".
" ... Einstein, because when one says scientist he is conceived. His fluffy hair … (Male, 82)".

When we examine the reasons for students' answers, it can be seen that the scientists were associated with their discoveries or inventions as a rule and considering the effects of those discoveries on human beings and society, the student teachers explained why these scientists were important. Yet, it should be noted that the teacher candidates' list of adopted scientists included few Turkish scientists. Hence, it can be concluded that the students have a scarce amount of information about scientists.

Findings about the scientific attitudes of teacher candidates

The scientific attitudes of students were measured with scientific attitude scale and their levels of scientific attitudes were shown in Table 14.

When the data in Table 14 is examined, it can be seen that the scientific attitude scores of female students were higher than male students. When looked at the total scores, it can be said that the scientific attitude levels of students were high. We attempted to examine the scientist images drawn by the student teachers having high scientific attitude levels. For this aim, the following strategy was followed in order to select the individuals with high level of scientific attitude (Tekin, 1996).

Since the scientific attitude scale were formed in 5-point type;
Range Width = Sequence Width / Number of Groups to be Formed
Range Width = 4/5
Range Width = 0.8

Table 16. Activity carried out by the scientist drawn.

Activity	f	%
Thinking	22	31.4
Lecturing	1	1.7
Experimenting	25	36.4
Inventing	1	2.5
Resting	1	0.8
Observing	2	4.1
Making Chemical Weapon	3	3.3
Eating	1	0.8
Researching	11	9.9
Blank	3	6.6
Total	69	100.0

Table 17. Data about the place of scientist.

Place	f	%
In the laboratory	61	82.6
At home	2	3.3
In the nature	2	2.5
In the study room	1	2.5
Blank	3	6.6
Total	69	100.0

The Group Range Values were found as (Table 15). The student teachers (total 69 students) with high attitude scores (3.40 X 40 = 136) were selected and their views about scientists were investtigated (Table 16 and 17).

Data about the activity of the scientist drawn: The views of teacher candidates about the activity and the place of the scientist drawn are shown in Table 16 and 17.
When we examine the data in Table 16, it can be seen that student teachers usually imagined scientist as carrying out scientific studies (thinking, experimenting, inquiring and so forth).

Below is an example for the pictures drawn by the students (Figure 5). When the drawing is examined, it can be seen that the students with higher attitude scores imagined scientist as experimenting in a lab, that is, in a more scientific environment (Table 17).

When the data in Table 17 is examined, it can be seen that the student teachers mostly imagined scientists as working in scientific environments (example, in a lab).

RESULTS AND DISCUSSION

According to the study data, it was found that science teacher candidates imagined scientists as careful, intelligent, creative and hardworking, whereas some characteristics of scientists such as being artistic was not usually taken into account.

Furthermore, when the students are asked to imagine themselves as scientists, the characteristics such as

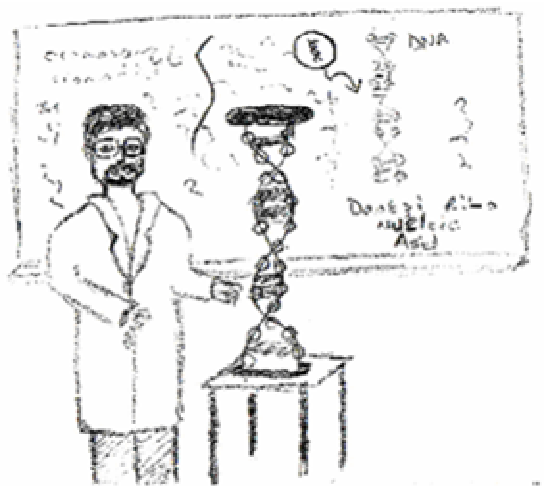

Figure 5. Here, scientist is drawn in a biology lab, as male and at 30s - 40s (Male, 98).

being careful, intelligent, responsible and peaceful appear to outdo the others (Table 4 and 5).

When the physical qualities of the scientists drawn by the students are examined, it was found that the scientist image was usually male even in the minds of female student teachers (Table 7). Previous studies reported similar results (Badin and Gehringer, 2001; Fung, 2002; Rubin et al., 2003, etc.) Teacher candidates usually did not image scientist as very old. The scientist images depicted were generally at around 30 s (Table 7). The activities of scientists were generally imagined as experimenting, thinking, and inquiring and they were drawn primarily in a laboratory.

Few students drew scientist out of a scientific setting (Table 8 and 9). This implies that the students view scientists solely as conducting scientific studies. Also regarding the physical appearances of the scientists, they were mostly described as wearing glasses, having a weird hair style, in a laboratory wearing a lab coat, having beard and being balding (Table 10). Previous studies report similar results (Bodzin and Gehringer, 2001; Schibeci, 2006; Fung, 2002; Song and Kim, 1999; Balkı et al., 2003; Mason et al., 1991, etc.).

It was found that the scientist image in the student teachers' minds affected from life stories of the scientists most and visually the movies and animation movies appear to have a significant effect on this process (Table 11). Dhingra (2003) claimed that visual and written environmental factors may have many positive or negative effects on the scientific thinking and science literacy of individuals. Taken this for granted, environmental elements that can contribute to the scientific thinking of students should be prepared and implemented. The teacher candidates usually stated that they usually saw nobody that can be described as a scientist (Table 12).

The mostly adopted scientists were Einstein, Newton and Edison and from Turkish Science World few scientists were mentioned (Oktay Sinanoğlu, Mimar Sinan). This implies that the student teachers lacked in being aware of the Turkish scientists (Table 13).

When we look at the scientific attitudes of teacher candidates, it was shown that the scientific attitudes of females were way higher than the males. When we evaluate as a whole, the scientific attitudes may be considered as high. Looking at the scientist images composed by student teachers with higher levels of attitude, it was seen that the student teachers described scientists as conducting studies in scientific settings. In this sense, students' high level of scientific attitudes may be associated with the scientific content of the pictures they drew.

Generally, the significance of informing student teachers about scientific method, scientists, science and the nature of science were underscored. When we examine the new science education program of Faculties of Education in Turkey, it was observed that some new courses named as "The Nature and History of Science" and "History of Turkish Education" was added to the program. We claim that effective implementation of these courses will add to the views of student teachers on science and scientists. Moreover, in the courses, ample knowledge should be presented to students about science, the lives of scientists and scientific methods and their applications should be implemented by the students per se. Positive impacts of the studies towards enhancing the knowledge of students on the nature of science and scientific knowledge were reported (Bodzin and Gehringer, 2001; Scherz and Oren, 2006; Kang et al., 2005; Morrison et al., (in the press); Eijck et al., 2008; Smith and Erb, 1986; Maoz and Rishpon, 1990; Flick, 1990, Demirbaş and Yağbasan, 2005, 2006b, 2007; etc.).

The following recommendations can be made according to the results of this study;

In addition to the existing courses in the renovated Science Education Program, several courses in which scientific method, scientists and scientific processes may be studied should be offered.

For the courses addressing scientific methods; scientists should be invited, the students should be allowed to observe these scientists at work and interactions between the students and these scientists should be arranged. The number of movie-like materials introducing the stu-dies of scientists is very scarce. Hence, having pene-trated into the field, the works of scientists should be filmed and distributed.

The teacher candidates should be informed about how scientific visits should be carried out and they should experience these visits and increase their consciousness as far as possible. For the instructional settings where this kind of visits is arduous, interactive instructional methods should be considered.

APPENDIX: Scientist image scale.

QUESTIONS

1. What do you think of the characteristics of scientists? (Circle the appropriate number choice for each item. Numbers represent the degree of agreement with the concerning opinion.)

Careless	1	2	3	4	5	Careful
Silly	1	2	3	4	5	Intelligent
Lazy	1	2	3	4	5	Hardworking
Non Creative	1	2	3	4	5	Creative
Selfish	1	2	3	4	5	Caring
Conservative	1	2	3	4	5	Open-minded
Boring	1	2	3	4	5	Exiting
Artistic	1	2	3	4	5	Not Artistic
Not Humanist	1	2	3	4	5	Humanist
Irresponsible	1	2	3	4	5	Responsible
Irreligious	1	2	3	4	5	Religious
Not Peaceful	1	2	3	4	5	Peaceful

2. If you were a scientist, which characteristics would you have? (Circle the appropriate number choice for each item.)

Careless	1	2	3	4	5	Careful
Silly	1	2	3	4	5	Intelligent
Lazy	1	2	3	4	5	Hardworking
Non Creative	1	2	3	4	5	Creative
Selfish	1	2	3	4	5	Caring
Conservative	1	2	3	4	5	Open-minded
Boring	1	2	3	4	5	Exiting
Artistic	1	2	3	4	5	Not Artistic
Not Humanist	1	2	3	4	5	Humanist
Irresponsible	1	2	3	4	5	Responsible
Irreligious	1	2	3	4	5	Religious
Not Peaceful	1	2	3	4	5	Peaceful

3. Draw the picture of a scientist you imagine. While drawing, consider the qualities below.

a. The gender of the scientist you draw: O Male O Female
a. The age of the scientist you draw: O 10-20, O 20-30, O 30-40, O 40-50, O 50-60
c. What is the scientist you drew doing? .....
d. Where did you draw in the picture? Where is the scientist in the picture?

(Draw the picture in the blank space below)

4. For the scientist you imagined and drew with the qualifications you mentioned above, which of the following affected you most? (Select three of these, if there are any other than these please write it.)

O- Life stories of Scientists	O-Scientific Journals for Kids	O- Textbooks	O- Journals
O- Animation Movies	O- Museum Visits	O- Teachers	
O- Movies	O- Cartoons	O- TV Series (Name :……)	
O- Mother and Father	O- Internet	O-Others (Describe……)	

5. Who do you see around as a scientist? Explain why. (If you don't choose anyone, then write nobody and explain why.)

Who:……
……..

Why:……
……
……

6. Which scientist do you adopt most? Explain why.
Scientist:……
……..

Why:……
……..……
……

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