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WOMEN SCIENTISTS IN SCIENCE AND TECHNOLOGY TEXTBOOKS IN TURKEY

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Abstract. *The purpose of this study is to determine the amount of inclusion of woman scientists in the textbooks prepared in accordance with the 2004 Science and Technology Curriculum in Turkey. The study is a descriptive field study since it proposes an assessment of the situation. In the study, document analysis was conducted. The 4th to 8th grade textbooks were analysed. It was identified that, despite the aim to include men and women who contributed to science in the science and technology curriculum, the textbooks do not reflect this sufficiently. In the textbooks, even though a total of 78 different scientists are mentioned, only two of these are women. It is important to include women scientists in science textbooks for girls to be able to find the role models they need when choosing a career Therefore, women scientists who contributed to science should be included in textbooks and this must be reinforced with one-to-one activities. In addition, it is important that teachers be sensitive and informed on this issue.*

Key words: *history of science, role model, science education, science textbooks, women scientists.*

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Introduction

Science is a activity progressing with human contribution. Within this activity, both men and women have important contributions. However, as an extension of patriarchal societies, men are prominent like many other fields and their contributions are mentioned more.

Why women do not exist in the science world as they should is still controversial. Bowling and Martin (1985) explain that male domination in science is based on male control of dominant social structures, and the exclusion of women from positions of power through means such as direct discrimination, socialisation and gender division of labour, with a mechanism not recognised even by men. They further state that the accumulation of knowledge in science is masculine and is built on hierarchy, ignoring the women experience.

This approach dominating the science world (Ergin, 1997; Koehl, 2005; Kohlstedt & Longino, 1997) is also apparent in the field of education. In the books which are the main sources used in classes, there are mostly men in drawings and pictures. Walford (1981), in his study where he analysed the textbooks of physics, discovered that woman representation was low in number and besides, in the drawings and pictures where they were present, they were passive audiences to scientific activities, always conducted by men and there were no messages about the fact that they can be included in physics studies. Women who have contributed to science have been neglected in science education as well for a long time (Clary & Wandersee, 2006); the examples of scientists in the curriculum and textbooks were mostly men (Kleinman, 1998). It is observed that this situation caused students to perceive science as a male activity. In the studies on students' perception of a scientist, it was observed that students draw scientists as people wearing eye-glasses and white lab coats, working in a laboratory, ragged and with messy hair and it was observed that scientists

were depicted mostly as male in these drawings. (Fralick, Kearn, Thompson & Lyons, 2009; Kahle, 1989; Kaya, Doğan & Öcal, 2008; Korkmaz & Kavak, 2010; LaFollette, 1988; Mead & Metraux, 1957; Parsons, 1997; Rubin & Cohen, 2003; Song & Kim, 1999; Türkmen, 2008). This perception is strengthened through story books, magazines and cartoons (Clark, 2003; Flicker, 2003; LaFollette, 1988; Fullilove, 1987) and it becomes more dominant through men being used as examples of people who contributed to science in textbooks. For example, in a study where girls had questions on their desire to be a scientist, it was observed that they answered as "I cannot be a scientist, because I am a girl" (Oğuz Ünver, 2010).

Problem of Research

It is known that gender based guidance (Arat, 2010) or public opinions of professions are known to be an important factor in the choices and attitudes of students. In the studies on girls' interest in science classes, their success in these classes and their career selection (Blickenstaff, 2005; Yanowitz & Vanderpool, 2004), it was observed that the results were not very positive, that girls were less interested and consequently less successful and that girls did not pursue careers in science and engineering (Buck, Clark, Leslie-Pelecky, Lu, & Cerda-Lizarraga, 2008; Scantlebury & Baker, 2007). It was reported that there are many reasons for this, but, social roles imposed on girls as well as the absence of woman role models in science and engineering (Blickenstaff, 2005; Markert, 1996; Wyer, Schneider, Nassar-McMillan & Oliver-Hoyo, 2010;) were important factors because, research have shown that students are inclined to select careers depending on the existence of a role model in that career path when selecting their careers (Bailer, 1998; Buck, Clark, Leslie-Pelecky, Lu & Cerda-Lizarraga, 2008; Zirkel, 2002). Kleinman (1998) also discusses the prevalence of role expectations for women and ways in which this precludes them from careers in science. She points to the fact that women often cannot see themselves in such careers because they lack role models or examples of women who have successfully done so. Therefore, to create a healthy perception in career selections and understanding of science, it is important to pay attention, to ensure that examples of people from various professions and scientists in the process of education and in the textbooks, which are one of the most important materials of this process, are of both genders. Thus, girls can both notice the existence of women in science and meet with people they can hold as role models. This will also help them trust themselves and to be encouraged to take an interest in science. Because of this, it is important to give examples of women role models to students, especially to girls. In the lessons, textbooks are very often used as teaching tools, so it is important what and how is told in the textbooks. In this research, it is examined that how often the science and technology textbooks give examples of women scientists in the texts. It is necessary to show role models to girls and encourage them to choose science careers in the future.

Methodology of Research

Method

The study is a descriptive field study since it proposes an assessment of the situation. In the study, document analysis was conducted. Document analysis is analyzing the written materials which have information about the case or cases which are aimed to be investigated (Yıldırım & Şimşek, 2003). The 4th to 8th grade textbooks prepared in accordance with the 2004 science and technology curriculum by the Ministry of National Education were investigated by descriptive analysis. In descriptive analysis, the data gathered through document analysis are assessed according to previously determined themes. It was attempted to determine which scientists were included in the textbooks and how many of these were women.

Sample

The textbooks investigated in this study were grade 4-8th. Science and Technology textbooks which are prepared in term of the 2004 science and technology curriculum, pressed by The Ministry of National Education.

The 2005 science and technology curriculum has adopted the constructivist learning theory and was presented as a curriculum where students were asked to be active and one that aims to improve research skills. The purpose of the curriculum is to raise scientifically literate individuals. Students were asked to think as scientists and to solve the problems. History of science was also included in the curriculum and students were presented with the examples of contributions of scientists. The expectations from the students in the curriculum were stated as "acquisition". When the curriculum is analysed, it is observed that, among the acquisition related to history of science are "He understands that women and men can choose theoretical and applied science as professions and that they can advance in their careers" and "It shows that women and men of different cultures have contributed and continue to contribute to science and technology". In other words, the curriculum aims to present examples of the contributions of both men and women to science. This is a positive step to setting forth the existence of women in science. However, it is a point of curiosity how much this is reflected in the books prepared in accordance with the curriculum. Accordingly, it is thought to be necessary to determine the extent of the representation of women who have contributed to science in textbooks.

Data Analysis

For data collection, first the books were analysed to identify how the subjects were explained. It was observed that different headings were used in the lectures in textbooks. The subjects were explained in texts while interesting and striking points were presented under the heading "Did you know?", additional information or stories about scientists were presented in "colourful boxes/bubbles", historical progress was presented through historical timelines, research homework was presented with the heading "research and get prepared", experiments and student projects were presented under the heading "activities"; summary and evaluation questions were given at the end of each unit. Unit introduction sections, activities, end-of-unit summary and evaluations were excluded from the analysis. When the books were analysed, each heading was handled individually and the names mentioned more than once under the same heading were coded only once. How many times the scientists were included in the books were determined and presented in tables.

Results of Research

The results of the analysis of textbooks prepared in accordance with 2004 science and technology curricula are presented in tables.

Table 1. Scientists included in the 4th grade science and technology textbook.

Scientist name	How many times its given in the book	Scientist name	How many times its given in the book
Andres Celcius	1	Alexander Fleming	1
Isaac Newton	1	Michael Faraday	1
Thomas Edison	2	Alessandro Volta	1
Lewis Howard Latimer	1	A young woman geologist	1
Antoni van Leeuwenhoek	1		

As can be seen in Table 1, nine scientists were included in the 4th grade textbook. However, only one of these is a woman and she is a young geologist.

Table 2. Scientists included in the 5th grade science and technology textbook.

Scientist name	How many times its given in the book
Isaac Newton	1
Graham Bell	1
Thomas Edison	1

When the 5th grade textbook was analysed, it was observed that a very small number of scientists were included. It was observed that there were no woman scientists.

Table 3. Scientists included in the 6th grade science and technology textbook.

Scientist name	How many times its given in the book	Scientist name	How many times its given in the book
Robert Hooke	1	Edward Jenner	1
Isaac Newton	1	Louis Pasteur	1
Democritus	3	Robert Koch	1
John Dalton	3	Martinus Beijerinck	1
Marie Cruie	*2*	Alexander Fleming	1
Henri Becquerel	2	Jonas Salk	1
Pierre Curie	1	Joseph Montgolfier	1
Benjamin Franklin	1	Etienne Montgolfier	1
George Simon Ohm	1		

In the 6th grade textbook, 17 scientists were included. However, it can be seen that there is only one woman scientist (Marie Curie) amongst these as well.

Table 4. Scientists included in the 7th grade science and technology textbook.

Scientist name	How many times its given in the book	Scientist name	How many times its given in the book
Andre Marie Ampere	2	Newton	1
Benjamin Franklin	2	Ali Kuşçu*	1
George Simon Ohm	1	Uluğ Bey*	1
Alessandro Volta	2	Bursalı Kadızade Rumi *	1
Robert Boyle	1	Gıyaseddin Cemşid*	1
Democritus	2	Muinuddin Kaşi*	1
Albert Einstein	1	Hipporkhos	1
Marire Cruie	1	Galilei Galileo	1
John Dalton	1	Neil Arnstrong	1
John Joseph Thomson	1	Edwin Aldrin	1
Ernest Rutherford	1	Michael Collins	1
Neils Bohr	1	Archimedes	1
G. Stoney	1		

**Muslim scientist*

When looking at Table 4, it can be seen that 23 scientists were included in the 7th grade textbook. It can be seen that, like the 6th grade textbook, there was again only one woman scientist, and that she was Marie Curie.

Table 4. Scientists included in the 8th grade science and technology textbook.

Scientist name	How many times its given in the book	Scientist name	How many times its given in the book	Scientist name	How many times its given in the book
Gregor Mendel	5	Blaise Pascal	1	Michael Faraday	1
James Watson	1	Otto von Guerrike	1	Nicola Tesla	1
Francis Crick	1	Torricelli	2	Enrico Fermi	1
Farabi*	1	Johann Döbereiner	1	Arno A. Penzias	1
İbn-i Sina*	1	A.B.De Chancourtois	1	Robert W. Wilson	1
İbn-i Miskeveyh*	1	John Newlands	1	John C. Mather	1
Lamark	1	D. İ. Mendeleyev	3	George f. Smoot	1
Darwin	1	Lothar Meyer	1	Newton	1
Wallace	1	Henry Moseley	1	George Lemaitre	1
Leonardo da Vinci	1	Glenn Seaborg	1	Edwin Hubble	1
Wright kardeşler	1	Graham Bell	1	Alfred Wegener	1
Archimedes	2	James Prescott Joule	1	Hary H. Hess	1

**Muslim scientist*

When Table 5 is analysed, we can see that more scientists were included in the 8th grade textbook than other books. However, there were no woman scientists among the names.

Discussion

Students' thoughts about scientists are very important as they can affect their attitude to and interest in science (Losh, Wilke & Pop, 2008) and their selection of a career. Therefore, it is very important to pay attention to creating the correct image through expressions and drawings of scientists. Contributions of not only men, but also of women should be mentioned when giving examples of scientists. Thus, it would be possible to create a more "balanced" perception of science in terms of gender (Gilbert & Calvert, 2003).

It was identified that, despite the aim to include men and women who contributed to science in the science and technology curriculum restructured in 2004 in Turkey, the textbooks prepared in accordance with the curriculum do not reflect this sufficiently. In the textbooks (4th to 8th grade), even though a total of 78 different scientists are mentioned, only two of these are women. One of these women is Marie Curie, the other is a young geologist. The woman geologist in the 4th grade book is photographed when working on the field. Marie Curie is included in the 6th and 7th grade textbooks, her life and contributions to science are mentioned.

When looking at the history of science, it is possible to see many women who have contributed to science. Marie Curie is the one that is most known among these examples and she is already included in science books. However, there are many other woman scientists that could have been included in the textbooks who have made important contributions to science. German biologist Maria Sibylla Merian, who contributed to science with her work on caterpillars and butterflies, Maria Mitchell who discovered a comet, Lise Meiter who calculated the energy released during nuclear fusion and thus contributed to the development of the atom bomb, Gerty Radnitz Cori who researched how the cells

use food and convert them into energy, the Nobel prize winner in chemistry Irene Joliot-Curie who conducted research on the synthesis of radioactive elements, Nobel prize winner in medicine Barbara McClintock who has studies on genes, Nobel prize winner in physics Maria Goeppert Mayer who discovered nuclear shells, Rosalind E. Franklin who made important contributions in the discovery of DNA's helical structure are only a few of the many examples that could have been given in science courses. Despite this fact, very few woman scientists were included in the science books in Turkey, and the examples given were always the same names. In the studies on the scientists the students know of, it is observed that woman scientists are very rare and the woman scientist that is known is mostly Marie Curie (Rubin and Cohen, 2003; Song and Kim, 1999). This fact strengthens the public opinion of science being men's work and especially affects the attitudes of girls in a negative way.

Students learn about the scientists they know mostly from school, books, television and their surroundings (Rubin & Cohen, 2003). This fact shows how important it is to project the image of scientist accurately. In a study by Song and Kim (1999), it was discovered that girls gain knowledge of scientists mostly from textbooks. At this point, the importance of woman scientists to be included in textbooks becomes prominent. Through inclusion of woman scientists in textbooks, girls should be shown that they can conduct scientific studies like men that they can participate in scientific work, that they can use laboratory equipment and they should be encouraged. In the study "Women can be scientists, too" by Bailer (1998), the change in opinions about women becoming scientists had been researched. Students read biographies of woman scientists who contributed to science. At the end of the study, positive outcomes were observed about women scientists.

It is important to include women and woman scientists in science textbooks for girls to be able to find the role models they need when choosing a career (Watermeyer & Stevenson, 2010). Buck et al. (2001), in their study on scientists becoming role models, found that the students identified with role models according to people they had around them. In the beginning of the study, in which only girls participated, students stated that scientists cannot be their role models because they are mostly men and weird looking people. In the following stages of the study, students were brought together with woman scientists and they were made to talk with them and ask questions. After these group studies, it was found that their ideas of scientists not being their role models had changed. It was discovered that when teachers brought guests from different professions or science fields into the classroom and ensured that they spent some time with the students, this affected the career choices of students. At this point, it is important to bring woman scientists and students together.

Conclusions

It was seen that in the science and technology textbooks investigated in this study, scientists who were man have been mentioned predominantly. Only two examples have been given and one of them was a vey popular one (Marie Curie). As a result of this situation, students perceive science as a kind of men's work, especially female students discountenance jobs related to science and do not make career choices in these jobs. However, in textbooks and science lessons, if there were more expressions including women scientists, it would make science to be seen as an area which develops with contributions of both men and women and make female students tend to this area. Accordingly, in textbooks, contributions of women scientists should also be included as men scientists' contributions. Students should be informed about women with successful studies in science area. This will be a chance for girls to find role models for themselves. It is important that textbook writers mention contributions of women when they are giving examples about scientists. Moreover, teachers should also be sensitive about this issue. They should enrich their expressions/instruction by mentioning about contributions of both men and women scientists. For this to happen, teachers should also be informed about contributions of women scientists.

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