Exploring the gender gap and students' career choices in engineering: Experiences from Turkey

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Abstract

The shortfall of young people, particularly women, in the field of Science, Mathematics and Engineering (SME) has been shown in many national studies. Schreiner and Sjoberg (2008) indicated that boys outnumber girls in physics and engineering studies, while the gender balance is shifted towards the girls in studies including medicine, veterinary medicine, environmental science and biology. However universities, corporations, and others are becoming more and more aggressive at recruiting women engineers in almost all developed countries. Malicky (2003) explain the two important reasons to increase the number of women in the field of SME: they represent an untapped reservoir of potential employees, and they may bring new perspectives and ideas to meeting new challenges. This paper sets out to explore the issues which are relevant to understanding the gender differences and the factors affecting students' career choices. The instrument called "Vilje-con-valg" developed by Schreiner and Henriksen (2008) was used to obtain data from first year Turkish students enrolled at faculties of engineering.
Key words: Career Choosing, Science, Engineering, Gender, University students

Introduction

In the last 60 years, many sociological studies have been conducted to define career choosing in society. The concept of career was defined by Wilensky (1960) as "a succession of related jobs, arranged in a hierarchy of prestige, though which person move in an ordered predictable sequence" (p.127). The early studies showed that careers were a process by which the organizations rebuilt their systems (Gunz, 1989). As Wilensky mentioned, a person could have been pursued only in hierarchically arranged positions and required bureaucratic organizational structures in the early of 1950s. Later, studies shifted on the career routes. More emphasis has been given on how individuals affect and improve their own social relationships in organizations.

The gender issues in terms of career choosing started to take place in the studies during the 1980s. Women's minority career situation become more widely recognized and acknowledged by the researchers who began to develop their own ideas and concepts to explore issue of women and career (Silverstone & Ward, 1980; Spencer & Podmore, 1987; cited in Evetts, 1996, p.4). During 1990s and 2000s, women's minority particularly in the fields of science and engineering became one of the important issues and addressed in many studies and reports (EU, 2004; Jacobs & Simpkins, 2006; NSB, 2006). According to Dick and Rallis (1991), there has been an increase in the representation of women employed in the scientific and engineering professions over the last 15 years, but still participation of women in these careers remains disproportionately low. The reasons about "why more women don't choose careers in engineering and science" has been tried to explore by many studies during 2000s.

The Situation for Engineering Education in Turkey

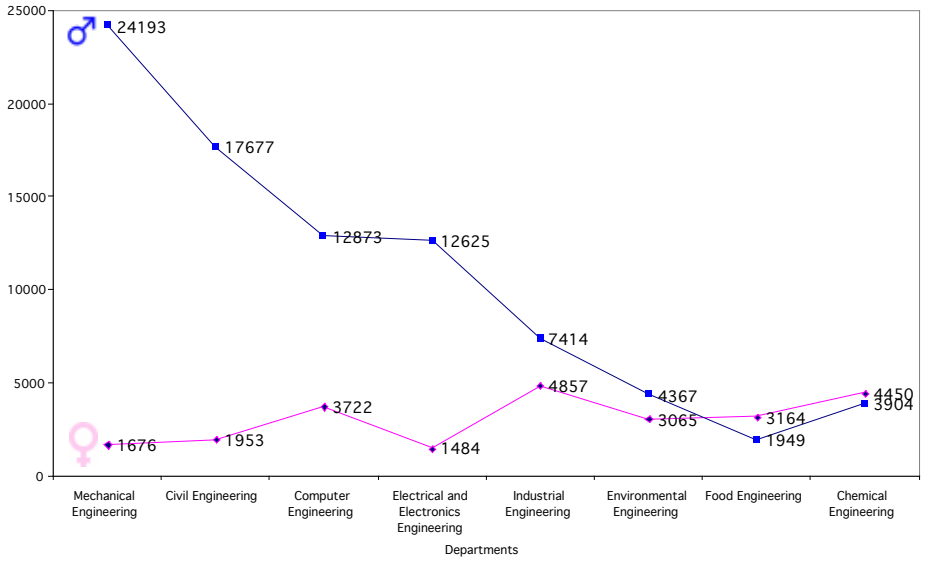
The engineering education in Turkey was started during the first quarter of 1800s. At the beginning of the first years, the engineering curriculum was quite overloaded. For that reason, the number of students was very low and also number of schools was limited. Important developments in engineering education were done with the reform and new engineering faculties were opened at the 1960s. These improvements stopped and were out of control during the 1970s. At the same years, engineering schools started to re-organize their educational programs with the intensive public stress. Nowadays, Turkey has many engineering faculties which train highly qualified engineers with contem-

porary educational methodologies in the modern campuses. However, some faculties have just founded with limited staff and infrastructures (Gencoglu & Cebeci, 2009).

As it shown in many countries, very few women in Turkey become engineers and a woman who consider engineering as a career often face reactions especially from their families, friends, and future colleagues. In many societies, it is supposed that the masculine image of science and technology is an important factor in women's career decisions about these fields (Newton, 1987). Although some engineering departments have the lowest percentage of female students (like mechanical, civil, electrical-electronics etc), woman are greatly represented in some of them (like food, chemical and environmental).

As it shown in Figure 1, while the percentages of female students in food engineering and chemistry engineering are 61.88 % and 53.26%, the females' percentages for the mechanical engineering, civil engineering and electrical and electronics engineering are 6.48%, 9.95% and 10.5% respectively. Basically these results show that there are significantly differences in many engineering departments in terms of gender. In a study carried out by Zengin Arslan (2002), engineering departments has been categorized into three groups. While masculine Engineering Departments are mechanical, civil, electrical and electronics, petroleum and metallurgical, feminine engineering departments are food, chemical and environmental. Mixed Sex Groups are geological, industrial, nuclear energy, computer, aeronautical, mining, hydrogeological and geophysical" (p.402).

Figure 1. The number of female and male students according to different engineering departments. Data obtained from Higher Education Council Statistics Book for 2007-2008 Academic Years



The purpose of study and research question

In the light of the above literature, this study aims to explore the issues which are relevant to understanding the gender differences and the factors affecting students' career choices in Turkey. This study therefore addresses the following research questions:

1. Which education levels do influence mostly students' career choices?
2. What are the effects of closer family members, teachers and friends' on the students' career choices in the field of engineering?
3. What are the effects of informal information sources (newspapers, popular magazines, museums etc.) on the students' career choices in the field of engineering?
4. What are the effects of university criteria on the students' career choices in the field of engineering?

Sample

The sample of the study consists of 221 first year students from five different departments-civil engineering, mechanical engineering, computer engineering, electrical-electronics engineering and industrial engineering at a major university in Izmir, Turkey. Of the 221 students (154 male, 67 female) who completed the questionnaire, 86 were 18 or 19 and 135 were 20 or 21-+ years old.

Instrument

In this study, standard survey methodology within the quantitative research tradition was used for data collection. The instrument was modified and adapted into Turkish Language from the "Vilje-con-valg" project's questionnaire which was developed by Schreiner and Henriksen (2008). Detailed information about "Vilje-con-valg" project can be found at the http://www.naturfagsenteret.no/vilje-con-valg/.

The instrument consists of twenty-eight sections including open-ended and Likert type questions. In this study, only four sections (students' education level, parents and close friends, informal information sources, university criteria) were analyzed and presented.

Reliability of the instrument was determined by computation of Chronbach's alpha. The standardized alpha scores for three sections are presented Table 1.

Table 1. Reliability analysis of the sub-scales

Scale	Number of Item	Chronbach's alpha
closer family members, teachers and friends'	6	.71
Informal information sources	12	.85
University criteria	15	.89

Findings

The female and males students' responses to the question "Approximately when did you decide on studying in this department?" are given in Table 2. In this section of questionnaire, students were asked to tick one or more statements which are suitable for them. According to results in Table 2, students' career choice decisions are affected by the period of last grade of high school level (females, 11.9%; males, 14.9%) but especially mostly affected by period of the graduation from high school (females, 62.7%; males, 53.9%).

Figure 2 shows closer family members, teachers and friends' effects on the female and male students' career choices. In this section students were invited to respond, using a four-point Likert-type scale ranged from small extent to great extent.

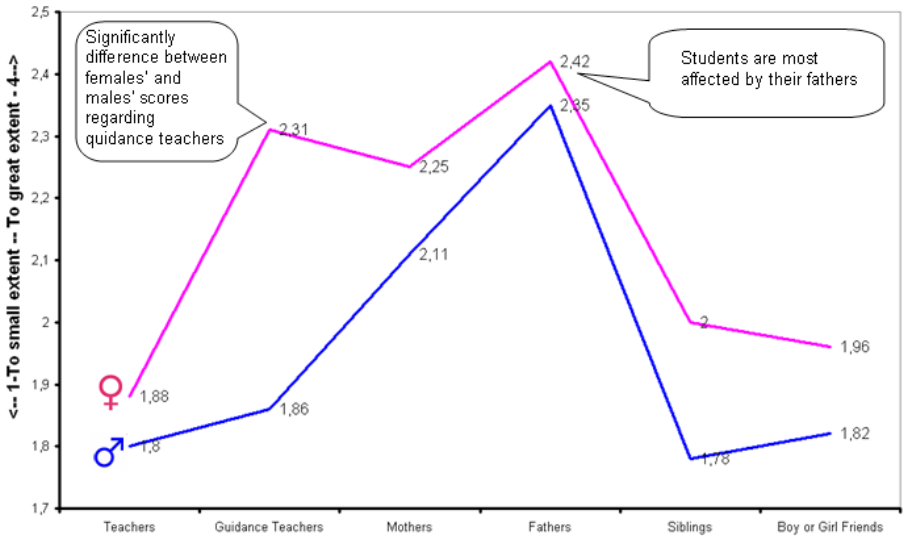
Table 3 shows mean scores of females and males students' response regarding effects of informal information sources (newspapers, popular magazines, museums etc.) on the students' career choices and independent samples t-test result.

Table 4 summarizes the responses regarding to the fifteen statements related to university criteria by gender.

Table 2. Gender differences in response to "Approximately when did you decide on studying in this department?"

Statements	Females (%)	Males (%)
1. Primary Education, Grade 1-5	1.5	3.2
2. Primary Education, Grade 6-8	1.5	3.9
3. High School, Grade 9	10.4	7.1
4. High School, Grade 10	6.0	12.3
5. High School, Grade 11	11.9	14.9
6. After graduation from high school	62.7	53.9
7. After having studied something else	4.5	1.3
8. I do not know	1.5	3.2

Figure 2. Gender differences in responses to "To what extent have you been inspired or motivated by the following in choice of your department?"



An independent-samples t-test was performed to clarify closer family members, teachers and friends' effect on the male and female students' career choices and presented in Figure 2. Only significant difference was found between females' and males' scores regarding guidance teachers. (M=1.86, SD=0.98 for females and M=2.31, SD=0.88 for males; t(100)=3.11, p=.002). There were no significant differences in the students' scores regarding other individuals' effects.

Table 3. Gender differences in response to "To what extent have you been inspired or motivated by the following in choice of your department?"

Statements	**Means**		**t-test**	**p-value**	**Cohen's d**
	Females	**Males**			
1. Newspaper articles	1.92	1.70	N. S. S. D.*		
2. Popular science book and magazines	2.40	2.11	1.98	< .05	.01
3. Other book and magazines	2.03	1.67	2.82	< .05	.01
4. PR posters and advertisements	1.81	1.66	N. S. S. D.*		
5. Internet	2.65	2.23	2.78	< .05	.01
6. Computer games	1.25	1.60	-3.16	< .05	.01
7. Museum/science center	1.60	1.53	N. S. S. D.*		
8. Popular science television channels/programs	2.05	2.41	-2.04	< .05	.01
9. Films and TV series	1.64	1.85	N. S. S. D.*		
10. Science weeks at the schools	1.65	1.53	N. S. S. D.*		
11. TUBITAK	1.71	1.62	N. S. S. D.*		
12. Science and Technique Magazine	2.09	2.02	N. S. S. D.*		
** Non significant statistical difference*					

Table 4. Gender differences in response to "How important are the following factors for your choice of study?"

Statements	Means		t-test	p-value	Cohen's d
	Females	Males			
1. High scientific standard of the university	3.00	2.67	2.56	< .05	.01
2. That the place has a good image and reputation	3.08	2.93	N. S. S. D.*		
3. Good social environment at the university	2.60	2.38	N. S. S. D.*		
4. That extracurricular student activities are arranged	2.48	2.07	2.74	< .05	.01
5. Personal follow-up from lecturers and advisers	2.36	2.07	N. S. S. D.*		
6. That you are not clearly under-represented as a girl/boy	1.54	1.63	N. S. S. D.*		
7. That you have boy/girl friends at the same university	1.73	1.44	1.99	< .05	.01
8. That you have siblings at the same university	1.25	1.25	N. S. S. D.*		
9. That the university has good international student exchange programs	2.85	2.14	4.71	< .05	.01
10. That the study program opens a range of different job opportunities	3.50	3.05	3.36	< .05	.02
11. That the teaching is adjusted to your level	3.18	2.71	3.42	< .05	.02
12. That you are comfortable with your fellow students	2.65	2.12	3.39	< .05	.02
13. That you are comfortable with the buildings, common areas, cafes	2.17	1.99	N. S. S. D.*		
14. That you see the relevance of what you learn for what you want to work with	3.27	2.83	2.95	< .05	.01
15. That you get challenges and changes for personal development	3.26	2.75	3.51	< .05	.02
** Non significant statistical difference*					

Table 3 shows informal information sources' effects on the male and female students' career choices. Independent samples t-test analysis of data indicated that significantly differences between male and female students' scores were found regarding statements 2, 3, 5, 6 and 8. This result indicate that female students' are more motivated in choice of their department by popular science book and magazines and internet compared to males, but computer games and popular science television channels/programs effects male students in their choice.

Table 4 summarizes the responses regarding to the fifteen statements related to university criteria by gender. An independent-samples t-test was performed to determine university criteria's effect on the males and females' career choices and presented in Table 4. Significant differences were found between females and males students' scores regarding statements 1, 4, 7, 9, 10, 11, 12, 14 and 15.

Conclusions

We here report the result of first year engineering students' career choices project to determine some important factors on the career choices. This study focused on the four important factors which are students' decisions at the previous education level, effects of closer family, siblings and friends, informal information sources and university criteria. The results are given item by item below:

- The study reveals that the first year engineering students identify their career choices in the period of last grade of high school and mostly after graduation from high school.
- In general, students are less affected by their parents, siblings and friends regarding career choices. Despite low mean values, fathers compared with other people have the most influence on their children's career choice. And guidance teachers have important influence on the female students.

- Popular science books, magazines, science TV channels, science and technique magazine (Bilim ve Teknik Dergisi) and mainly internet have a significant impact on the students' career choices.
- High scientific standard, good image and reputation, social environment, teaching facilities of university, challenges and changes for personal development and relevance of learning in the university are among the important factors in students' career choice.

Career choice is an important process for the information societies. Therefore, students' career choices must be taken into consideration. This study reveals that the students identify their career choices just before the university education level. This situation reflects that sufficient guidance is not provided to the students at the primary and high school education level. For this reason, necessary information and guidance should be given to students starting from the primary education level. In addition to families, guidance teachers should work more efficiently and should provide essential leaflets, bulletins etc. about career choices. More importance should be given to the media, internet and web pages regarding career choices. It is because internet has strong impact on the today's youth. Universities must prepare and design web pages and inform young people about their career choices.

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