A PREDICTED APPROACH TOWARDS WOMEN IN ENGINEERING EDUCATION/PROFESSION USING MACHINE LEARNING TECHNIQUES

Tahira Mahboob, Sabheen Gull, Zahra Saleem[1]

Abstract

Women have contributed to the diverse fields of engineering in modern and historical times. Women are often under-represented in the fields of engineering, both in academia and in the profession of engineering. A number of organizations and programs have been created to understand and overcome this tradition of gender disparity. In this paper we have applied a machine learning approach for the prediction of women in engineering in the coming future in Pakistan. We have identified several factors which influence the decision of women while selecting engineering as a profession.

Keywords: *Alternative hypothesis, ANOVA, Decision grounds, Engineering women, Independent factors.*

Introduction

Although the number of female engineers today has greatly improved since the early 1980s, but it's still surprisingly low. Reasons that have been suggested for low female graduation rates include lack of female engineering role models, misconceptions of what it is like to be an engineer, and having fewer technical problem-solving opportunities as compared to men, whereas lack of confidence is a huge factor, especially competing with men. The paper is organized as follows: Section 2 discusses the various studies related to women in engineering which have been done before. Comprehensive analysis of our machine learning approach is described in Section 3. Section 4 includes the observations; Section 5 includes the future prediction. Finally, section 6 concludes the study.

Literature Review

John (2006) aims to decide an exact measure of maintenance by following individual students through their science and engineering academic profession. It inspects the variables influencing maintenance of females in science and engineering. This study build the standards for dependability of female students seeking after degrees in science and engineering by giving interventions to the students themselves, basically during freshmen and sophomore years which are critical focuses. It reports these variables to the senior member and offices required for thought in approach advancement. According to Hamid (2009), today's engineering industry is overwhelmed by Males. What's more here women are affected by the way of work, impact of society and acknowledgment level of women in engineering. In past years women used to pick those ranges to work which they thought may be reasonable to them and affirmed by society. After 1990's, the pattern changed in Malaysia after their Seventh Malaysian arrangement endorsement. This paper concentrates on researching the desire of ladies behind picking engineering as an expert degree in UTEM. The investigation of information demonstrates that between the years 2005 to 2008, number of graduated female understudy expands each year with the exception of 2007. Zengin Arslan (2002), Depends on a detailed study made on the female students in engineering offices in Turkey. This lets us know that women are fit for speaking to themselves in this field to some degree however an itemized examination

---

[1] Department of Software Engineering, Fatima Jinnah Women University

uncovers that the circulation of female students in engineering offices is not even as they exist in this government w.r.t their gender roles. As it were, regions that can be portrayed as `masculine' engineering offices and `feminine' engineering offices have been framed and the choices of female and male students in their decisions of divisions have been influenced by this arrangement. This evaluation is a result of the meetings that have been led with 15 women engineers from February 2000 to April 2000 in Turkey. Their encounters amid their instructive period with institutional structures and people, for example, teachers and alternate students, and their talks on `engineering' and their own particular offices are emphasized.

Imran (2014), on the base of various studies, has found that that less women get enrolled in science and technological zones of study. And among those who get enrolled, very few gets graduated. If statistics from UAE and other universities are compared, it is seen that ratio of women students is significant in engineering programs. This paper studies the intake, and retention of women and men related to their accredited in engineering programs.‖ Women included 44% of the total enrolment in academic years 2006 to 2010. Until the academic year 2013–14, 23% women and 37% men aborted their programs while 77% women and 63% men were retained. From those who aborted, 85% women and 82% men did so within the first three semesters of admission. Marion (2000), Conducted a survey on 130 engineering institutes covering 55 countries. On the basis of these results this paper discusses the preliminary results on changing trends of women in engineering worldwide. This study also includes the data from time period of 1960 to 1997. The problems faced by women engineers are also discussed. Several hypothesis are also discussed which are used to explain the data and then the hypothesis are approved or disapproved on the basis of added data and research. It is also identified that in what areas there is still a need for further research regarding women decisions in choosing engineering as profession.

According to Hawks (1998), Women are underrepresented in the field of engineering mainly is explained by the gender differences in occupational interest, attitudes or abilities. This paper aims to examine the gender differences hypothesis as well as expected role conflicts of female and male students. The academic, career, and family attitudes and expectations of women and men majoring in engineering are explored. Men and women are extremely similar in their abilities, academic experiences, and career influences. However women are more likely to lag behind due to the lack of confidence in their own abilities and conflicts between work and family responsibilities will be obstacles to success in their careers. These differences along with the orientations toward family roles, suggest that a role conflict argument better accounts for the disproportion in the career development of men and women engineers. Suggestions for addressing these role conflicts before women begin working as engineers are also discussed in the paper. Blaisdell (1994), Presents a review empirical literature concerning the under representation of women in science and engineering is presented. The elements required in this underrepresentation are societal changes; scientific ability, early adolescence socialization, training, self-adequacy, view of engineering; profession decision and industriousness are incorporated.

Kalkan (2002), Talks about the incredible condition and complexities the genuinely unique social (convention forced) and proficient (state-forced) parts of women engineers in Turkey. The discourse is exhibited as far as three classes, specifically,

women as academics, engineers and students in engineering. A few examinations are likewise made between the expert status of female engineers in the United States and in Turkey. Mama (2003), Depicts the "Assessing Women in Engineering" venture which is utilizing a remarkable cooperation between a WIE chief and an Assessment expert to create exportable evaluation instruments and models for Women in engineering programs across the nation. Along these lines permitting them to survey their system's exercises and at last give information to settling on well-in framed assessment choices. Zastavker (2006), utilizes techniques for grounded hypothesis and correlational investigations to analyze how segments of Project based learning (PBL), for example, little gathering work, hands-on exercises, interdisciplinary teaching, and "true" associations – affect students, especially women's, enthusiasm for and dispositions around an early on engineering program. This subjective and quantitative pilot investigation was started at a little; gender balanced engineering school that utilizes PjBL as its primary instructing rehearses.
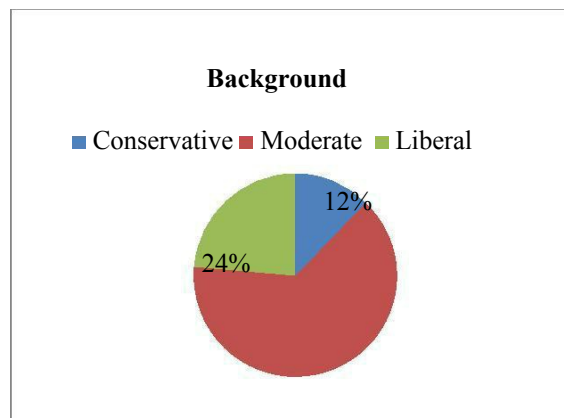
Sample

The survey questionnaire was filled in by 114 female students among which, 94 were the undergraduate students of different disciplines and 20 were the students of higher secondary schools. Whole sample population is female. Following are the samples of study.
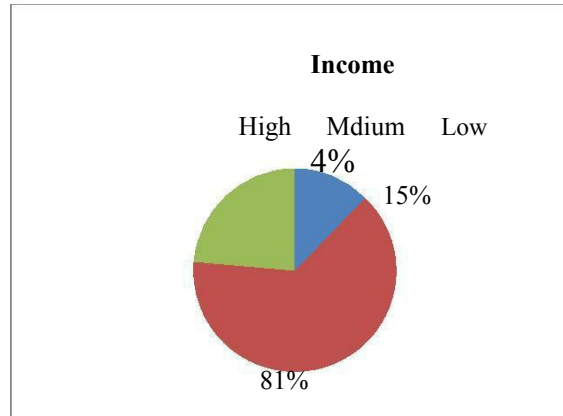
Degree
Bachelors HSSC
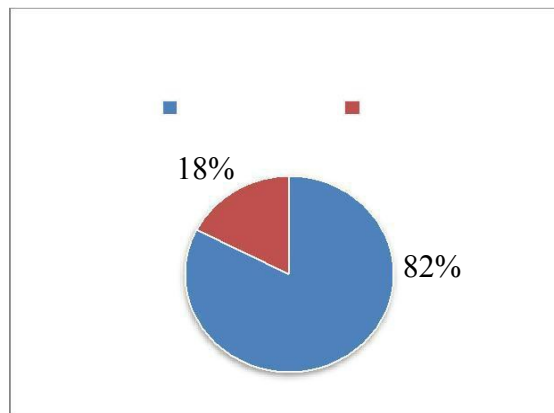
In the conducted survey, there was a categorization based on ethnic backgrounds, its summery is as follows.
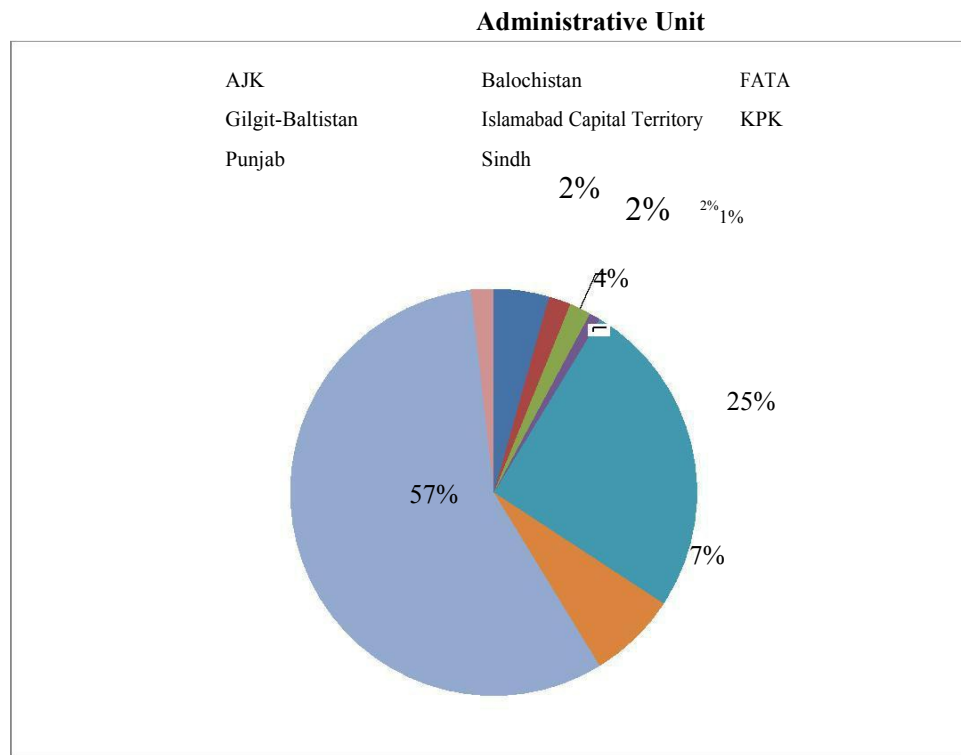
Another categorization scheme followed was family income

Income

High   Mdium   Low

4%

15%

81%

To maintain the diversity in our results, the samples were made to be filled by students belonging to different geographical areas in Pakistan.

Parameters	Median
Influence of society in general	3.00
Lower cost of studying the subject	3.00
Better facilities available at school	3.00
Lower level of difficulty in studying the subjects	3.00
Own ability or skill	**4.00**
Interest or passion	**4.00**
Improved Marital prospect	3.00
Greater chance of Pursuing the subjects at University	**4.00**
Lower cost of University education	3.00
Related subject taught at Pakistani University/colleges	**4.00**
Rules, provision, assignments suitable for members of my gender	3.00
Greater chances of employability	**4.00**
Higher future pay	**4.00**
Suitable work environment for members of my gender	3.00
Lack of Physical ability	3.00
Caste influence	2.00
Religious influence	3.0
Friends Influence	3.00
Schoolmates' influence	2.00
Teachers' influence	3.00
Career counsellor's influence	3.00
Role models' influence	3.00
Family influence	3.00

Administrative Unit

AJK	Balochistan	FATA
Gilgit-Baltistan	Islamabad Capital Territory	KPK
Punjab	Sindh	

Analysis

We identified 23 factors which may, according to us, influence the decision of women in Pakistan while selecting engineering profession. We assessed our study according to those factors. The research statistics of our study are as under.

4.1. Medians

Initially we selected 23 parameters which can be seen in Table1. Each parameter is assessed by comparing the median value of each single parameter. Threshold value is set to 3. Those parameters are chosen which are above threshold value. Comparing the median we came to a point where only 6 parameters are left at the end.(See Table1)

4.2. Independent t-test

Doing independent sample t-test for our data taking ―Program name‖ as an independent variable and the decision of participants of this survey is taken as dependent variable. The independent variable is divided in two groups namely engineers and non-engineers. The numbers 1 and 0 are assigned to each class respectively. The alpha value is assumed to be 0.05. If the value of p, i.e. sig value is less than 0.05, Null hypothesis will be rejected.

The basic idea behind doing independent value t-test is to compare the difference of means of the two classes of ―Program Name‖. This gives us the idea behind the decision making of engineers and non-engineers. In case of high variance, we can predict that among the following six variables, which one is important in decision making of each class.

Parameters and their medians

We chose two hypothesis namely null and alternative hypotheses.

Null Hypotheses: Engineers decisions=non-engineers decision

Alternative Hypotheses: Engineers decision!=non-engineers decision.

One-way ANOVA: One-way ANOVA is another test to check the significance of data in ordinal form. To make our study accurate, we calculated One-way ANOVA as well along with t-test

Table 2. Independent variable t-test

Parameters	Significance
Your interest/Passion	0.058
Your own ability/skills	0.000
Greaterchances of pursuing These subjects in college/university	0.888
Related subject taught at Pakistan college/ university	0.015
Greater chances of employability	0.972
Higher pay in the future	0.235

Table 3. One-way ANOVA

| Parameters	Significance
Your interest/Passion	0.098
Your own ability/skills	0.001
Greaterchances of pursuing these subjects in college/university	0.008
Related subject taught at Pakistan college/ university	0.872
Greater chances of employability	0.436
Higher pay in the future	0.317

Observations

On the basis of above calculation, we can deduce that ―Higher pay in future, Greater chances of employability, Greater chances of pursuing these subjects at Pakistani university/college‖ and ―Your interest or passion‖ fall in the category of null hypothesis. Whereas ―Related subjects taught at Pakistani school or colleges‖ and ―Your own skill or ability‖ fall in the category of alternative hypothesis. Thus we can deduce that among these two points, engineers and non-engineers think differently. Same results are obtained for both tests. All the significant values below 0.05 are preferred and chosen for alternative hypothesis. The lower significant value shows high variance in data.

So we can infer from the results that high variance is observed in skill/ability and related subjects taught at Pakistani institutes. Therefore if we need to know the behavior of undergraduate students, we can assess them across these two parameters

5.1   Predicting the Decision

Based on the three scales of Ethnic background (Conservative, Moderate, Liberal) and scales of Family income (Low, Medium, High) we can assess the survey results of Intermediate students which are total 19 in number based on one of the two selected parameters namely ―Skill/Ability‖ and ―Related subjects taught in Pakistani institutes‖. Following graphs summaries our study on these parameters

A. Your own ability or skill
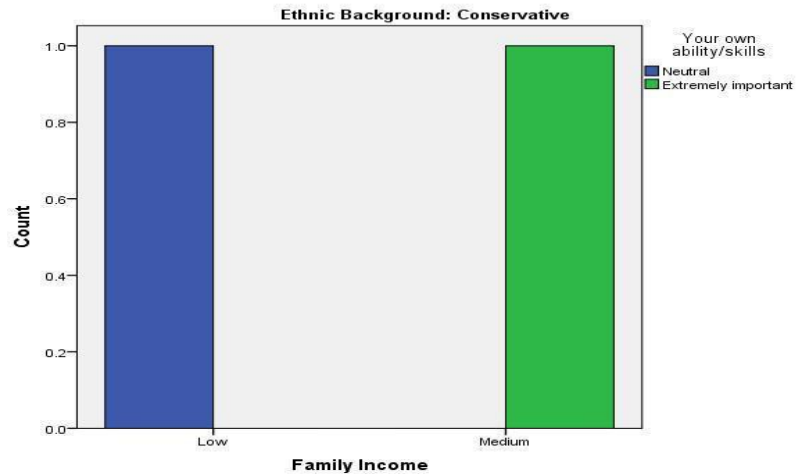
This graph shows that when an under graduate student belongs to family of conservative background and has medium family income, she has an extremely important decision based on her own skills. But when she belongs to a low income family, she does not consider her own skills much worthy.
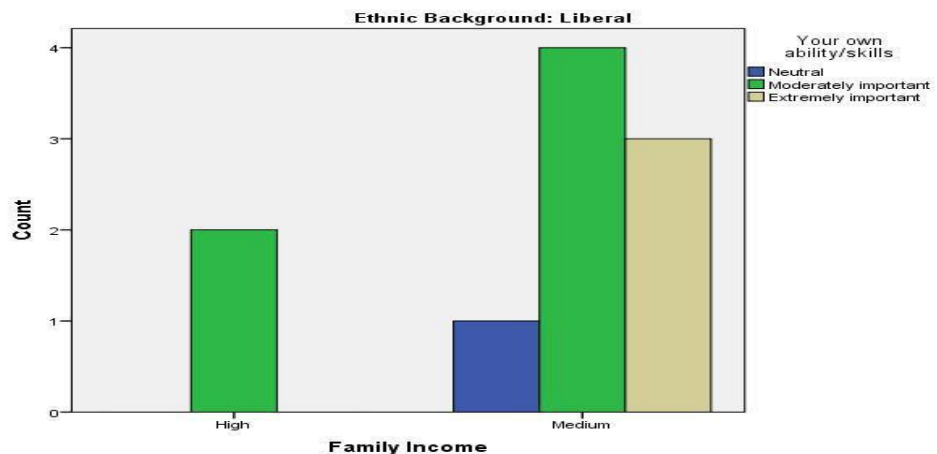

When a student belongs to a class of liberal background and family income is high, decision of choosing subjects if more or less moderately important. When the student is liberal and has medium income, she considers her skills to be of much importance to select a field.
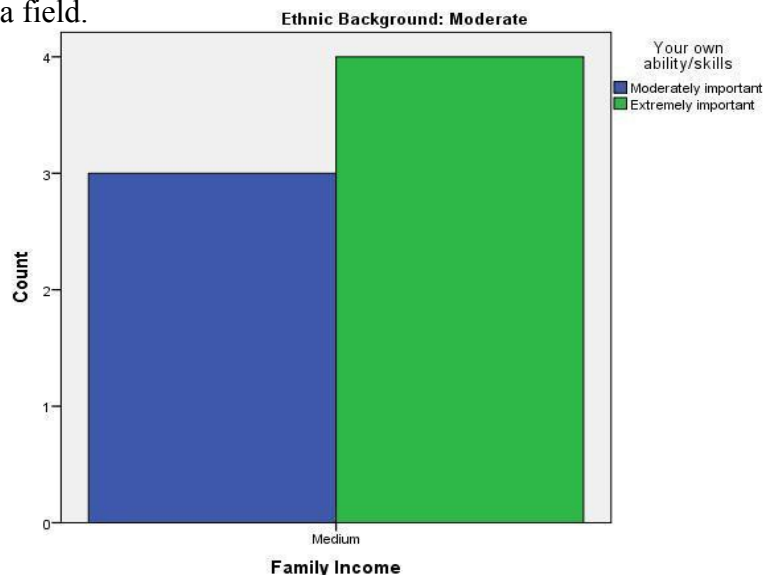
This graph shows that students with medium income and moderate background consider their skills to be more important in deciding their courses.

B. Related subject taught at Pakistani institutes:
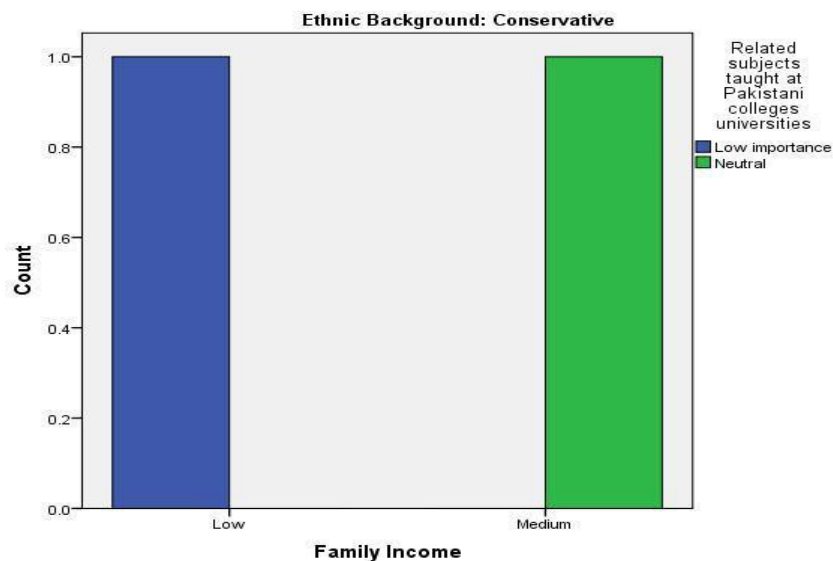
Intermediate students with conservative family background and low family income consider that related subjects taught at Pakistani institutes are not of much importance to them. While students with medium family income think that it is neither much important and nor of low importance to consider this parameter.

Female students with Liberal family background think that this parameter is important for them if they belong to high family income family. But we see variations when the income is medium. The average mean reaches up to 3 and says that this is extremely important parameter for such students with medium family income.
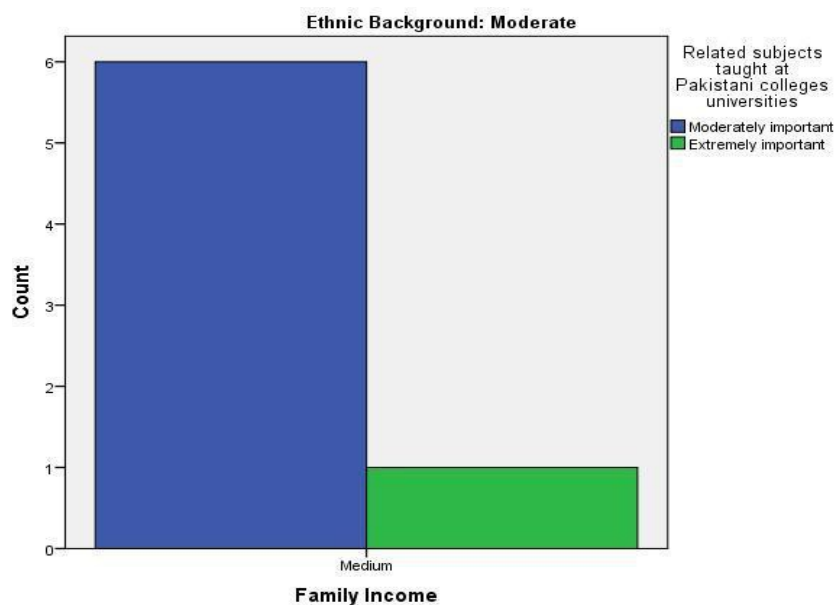
In moderate ethnic background and students belong to medium income family, trend is moving more towards moderately important, but still a mean of 1 shows that

some students still considers that related subjects taught in Pakistan is most important factor in their decision making.

All over we can see the swing in the decision making of intermediate students.

Conclusion

From the above discussion we conclude that a female student's skill/ability and availability of desired courses in Pakistani university are the significant factors which influence her to select engineering as a profession for herself or not. The prediction discussed here is of qualitative nature and also includes other social factor like family income and family background as a basis of decision. The point to focus is that, according to our survey, a vast majority of female students, either selecting engineering as a profession or not, considers their own skill and passion a point of decision, rather than any other social influence.

References

Brainard, S. G., & Carlin, L. (1997). A Longitudinal study of Undergraduate Women In Engineering And Science. *Frontiers in Education Conference* (p. 10). IEEE.

Hamid, N. A., Radzi, S. A., Noh, Z. M., & Ibrahim, M. (2009). Tendency of Women in Engineering Program Offered By UTeM. *lCEED* (p. 5). Kuala Lumpur, Malaysia: IEEE.

ZENGIN-ARSLAN, B. (2002). Women in Engineering Education in Turkey: Understanding the Gendered Distribution. *TEMPUS Publications*, 9.

Imran, M. N. (2014). Do Women Pursue Programs in Engineering? A Case Study from the United Arab Emirates. *International Conference on Interactive Collaborative Learning (ICL)* (p. 4). Dubai, UAE: IEEE.

Marion., Hersh. (2000). The changing position of women in engineering worldwide. *IEEE*, 345-359.

HAWKS, B. K., & SPADE, J. Z. (1998). Women and Men Engineering Students: Anticipation of Family and Work Roles. Journal of Engineering Education, 8.

Blaisdell, S. (1994). Factors in the underrepresentation of Women on Science And Engineering. *WEPAN National Conference* (p. 6). WIE.

Kalkan, M. (2002). WOMEN ENGINEERS IN TURKEY: PROFESSIONAL MODERNITY IN A TRADITIONAL SOCIETY. *Frontiers in Education Conference* (p. 1). Boston, MA: IEEE.

Mama, R. M., & Bogue, B. (2003). A.W.E. (ASSESSING WOMEN IN ENGINEERING) DESIGNING TOOLS FOR SUCCESS USING COLLABORATION. *Frontiers in Education Conference* (p. 5). Boulder, CO: IEEE.

Zastavker, Y. V., Ong, M., & Page, a. L. (2006). Women in Engineering: Exploring the Effects of Project-Based Learning in a First-Year Undergraduate Engineering Program. *Frontiers in Education Conference* (p. 6). San Diego, CA: IEEE