International Conference on

KNOWLEDGE & POLITICS in GENDER & WOMEN'S STUDIES

OCTOBER
9 – 11, 2015
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Technologic or Technophobic Youth: Preliminary Survey on Gender

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Abstract

Starting with the early use of Information and Communication Technologies, women have been perceived as less capable of using technologies or less successful in science in comparison to their men counterparts. Millennium brought new studies saying that the gap between men and women is getting lesser and more women are accessing, learning and working on technologies. On the other hand, women are still under-represented and less employed in ICT sector. In order to comprehend the underlying reasons of gender gap in ICT, researchers conducted a mixed-method research on undergraduate engineering education in a private university. Researchers used a sequential exploratory design for collecting and analyzing qualitative data first (n=54), and quantitative data (n=182) as two consecutive phases in one study was used to generate a questionnaire regarding with technologic and technophobic standpoints of university students. The major research question was originated as 'what underlying factor structure of the technologic and technophobic standpoints of university students toward gender issues' where more detailed research questions were created around variable comparisons according gender, engineering students' departments, students' grades and students' family cultures. Exploratory factor analysis revealed two factors; Factor 1 (named as physical-social) gathering around physical characteristics of gender and social consequences of the perceptions regarding ICTs and Factor 2 (named as interest-desire) explaining interest and desire levels of determinants regarding ICTs. Further analysis showed that only gender variable created a significant difference between factors.

Keywords: Engineering; ICT; gender; technophobia; family culture

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1. Introduction

There are many factors affecting prospective professional choices. Some of the factors are stemmed from innate (more physical) or inner (more psychological) issues whereas some of them are highly correlated with outer world, such as family, culture and economy. Among all these factors, gender is one of the constraints where women are selecting careers less in technology and science based professions (Mendick & Moreau, 2013).

There is a clear gap of equal gender representation in Information and Communication Technology (ICT) related fields. Furthermore, there is also an ongoing disparity in finding a technology related job for women. Additionally, women are less likely to get accepted for a higher order managerial work because of their family related issues (Ryan & Harden, 2014). On the other hand, ICT sector is experiencing shortage in finding employers which contradicts with the less employment rate of women in that field (Major, Morganson & Bolen, 2013).

There are some differences between men and women in terms of employment in engineering field. For instance; according to Ryan and Harden's recent research (2014), women are more committed to their jobs (especially IT related jobs as in their study) where work more years than men counterparts and less tend to change their jobs.

Within this gender-based differentiation circumstance, it is important to reveal how engineering students perceive gender based issues related to their prospective careers. In order to unfold these arguments, this study aims to generate a questionnaire regarding with technologic and technophobic standpoints of engineering students with a descriptive approach toward gender issues.

1.1. Related Literature

Engineers and scientists play an important role for the future of countries where they are stated overtly as "national priority" in reports. Although more female students are registering to undergraduate engineering departments in the last decade, women scientist or engineers are still under-represented in business (Sonnert & Fox, 2012). Similarly, many research results point out that there is a clear gap in women's contribution to business life for all professionals in Turkey. Even though female students are more and more registering to higher education and joining to work life, there is a high rate of female students regarding with graduating from university but not continuing working in their lives (Bucak & Kadirgan, 2011).

Major, Morganson and Bolen (2013) report that men and women who are working in ICT sector are having significantly different experiences in their professional lives. Although there is slight increase in number of women engineers in the last decade, culture based stereotyping toward women at work still plays an important role in many countries (Kodate, Kodate, & Kodate, 2014). Engineering, as a male dominant field of business, offers different experiences for men and women. Unfortunately, men's efforts are more appreciated than women's and women's income is discounting than their men counterparts. This adverse circumstance continues even when women are more educated than men (Joshi, 2014).

Ritzhaupt, Liu, Dawson, and Barron (2013) remark that there are plenty of evidences showing digital divide in terms of gender variable. Yet, there are also studies showing that regardless of this digital divide, women are better than men in schools for learning and using ICT. Ritzhaupt et al. (2013) urge that this contradictory result must be scrutinized and unfold the underlying reasons on both digital divide and performance issues.

Powella, Dainty and Bagilhole (2012) also point out the fact that engineering students are not knowledgeable enough about their prospective job, that is why they assume that engineering is more about men's job. In that sense, engineering students should realize women engineers and their success in order to improve or change the stereotyping toward women in engineering (Kodate, Kodate, & Kodate, 2014). Furthermore, the literature still discusses about to what extent women belong to engineering from different perspectives; suitability levels to profession, women engineer identity, appreciation of women engineers and managers (Hatmaker, 2013).

Beyond the discussion of feeling belong to engineer department, Powella et al. (2012) state that there are many factors for selecting a prospective job where youth particularly focuses on engineering as a well income, socially accepted, interesting and self-fulfillment career. One of these factors which the literature emphasizes is the gender. Powella et al. (2012) make a summary of their research and indicate that engineering students agree with the stereotype that engineering is more suitable as a man's profession where express the reason as an innate gender differences. Kodate, Kodate, and Kodate (2014) remark that this stereotyping which is totally gathered around society, culture and individual factors, adversely affect women at the very beginning where many of them hesitate to choose engineering as an occupation for themselves. Kodate et al. (2014) also highlight that catching the attention of women into engineering as a prospective profession is noticeably complicated.

In order to bring solutions to this complicated situation, Kolmos, Mejlgaard, Haase, and Holgaard (2013) unfold their research findings on motivational factors for choosing engineering as a career; intrinsic motivation, social appreciation motivation and economic motivation, whereas family or adviser based motivations were not listed as important factors. Moreover, male and female engineering students' motivations seemed to fluctuate from one engineering department to another. Female students were more attracted to choose or work in environmental, health, design and biotechnology engineering departments where more women are currently being employed.

In their research, Bucak and Kadirgan (2011) conducted a research with pre-university students who were in the process of selecting their departments. According to the study results, students' parents and career guiding services were depicted as the major factors in choosing a department (also a future career) for their higher education. Besides, "appropriateness of a profession to a man or woman" was listed as the least important factor for career decisions. This shows a slight change in Turkish youth for the realization of gender based biases toward workforce.

Sonnert and Fox (2012) state that in order to reveal the roots of gender gap in science and technology areas, researchers must start from undergraduate education in universities where students shape their professional identities for the future. Therefore, gender difference (or gap) in undergraduate engineering education is an essential topic for researches.

For this research study, following research questions were formulated;

- What is the underlying factor structure of the technologic and technophobic standpoints of university students toward gender issues?
- Is there any significant difference for the factor scores between females and males?
- Is there any significant difference for the factor scores among engineering students' departments?
- Is there any significant difference for the factor scores among students' grades?
- Is there any significant difference for the factor scores among students' family cultures?

2. Method

2.1. Procedure

In this research, a fully mixed-method design was employed in order to take advantage of both qualitative and quantitative methods for data analysis and interpretation. More specifically, a sequential exploratory design implies collecting and analyzing qualitative data first, and then quantitative data as two consecutive phases in one study was used to generate a questionnaire regarding with technologic and technophobic standpoints of university students. To generate questionnaire items, a qualitative survey consisted of 11 open-ended questions was administered firstly. After qualitative analyses of the data, major codes were generated according to students' different understandings of the technology usage, the role of technology in working life, and social media use. Having been reached a consensus on major codes between researchers, a questionnaire consisted of 45 items on a five-point Likert scale (from strongly disagree to strongly agree) was generated and administered. Regardless of theoretical constructs, the questionnaire was also consisted of demographic questions to be used for statistical analyses; gender, department, grades and family culture (liberal, democrat, conservative, modern and other). After collecting the quantitative data using the questionnaire, advanced statistical analyses were conducted to reveal engineering students' gender based issues about ICTs.

2.2. Participants

54 university students (15 female, 39 male) from departments of computer engineering and mechatronics registered on the private university in Turkey were voluntarily joined the first phase of the study (qualitative part). Based on the findings from this phase, the questionnaire was generated, and then administrated to the students as a main part of the research (quantitative phase). The sample for this questionnaire study included 182 university students (40 female, 142 male) from the departments of computer engineering, industrial engineering, civil engineering and mechatronics engineering. There were 31 first grade, 55 second grade, 37 third grade, and 59 fourth grade students in the study. Participants' demographics for both qualitative and quantitative phases presented in Table 1.

Table 1. Demographics of participants

		Qualitative Phase	Quantitative Phase
Gender	Female	15	40
	Male	39	142
Departments	Computer Engineering	30	88
	Mechatronics	24	27
	Industrial Engineering	-	23
	Civil engineering	-	44
Grades	1st	10	31
	2nd	18	55
	3rd	12	37
	4th	14	59
Family Description	Liberal	-	5
	Democrat	-	34
	Conservative	-	84
	Modern	-	47
	Others (Socialist, typical, etc...)	-	12

2.3. Data Analysis

Classic content analysis was used in the qualitative phase of the study to systematically code transcribed data, allowing the identification of key themes. After the discussion about the major concepts and themes, the codes revealed in the analysis were determined as possible questionnaire items. To assess reliability for this qualitative phase, analysis of the data was conducted by two of the researchers independently and 92% level of agreement was reached at the end of this process. As for quantitative data analysis, the IBM Statistics 20 was firstly used for the exploratory factor analysis. The exploratory factor analysis using the principal component analysis was applied to construct a questionnaire for measuring underlying variables (subscales) regarding technologic and technophobic standpoints of university students with a descriptive approach toward gender issues. A reliability analysis was conducted for the entire scale and for the subscales as well. The Cronbach alpha coefficient of an entire scale was .92, pointed out a high level of internal consistency of items. The coefficients of internal reliability for the subscales varied from .85 to .95. Moreover, the quantitative data has been examined with respect to assumptions of parametric test. The assumption of normality was not violated because of the large enough sample size (n=182). Levene statistics was used to determine the equity of group variances. For the analyses, t-test for independent groups and one way analyses of variance if the data provide assumptions of normality and homogeneity of variances has been computed.

3. Results

3.1. Exploratory Factor Analysis

To ensure the absolute sample size, the Kaiser-Meyer-Olkin measure of sampling adequacy was used before the analysis. The value 0.91 indicated that factor analysis was appropriate for these data. Moreover, Bartlett's Test of Sphericity was significant (p=.000), ensuring that the factorability of the correlation matrix could be sustained with these data set. The initial solution created so many factors and also eigenvalues which overlapped each other. Thus, the items that spread across the many factors with a less than 0.1 eigenvalue were removed from the analysis, then the analysis was re-run for several times to obtain reliable factor solutions. After completing the factor analysis, 17 items were deleted from the questionnaire. The remaining 28 items were categorized into two factors. It is possible to assert that a two-factor solution provided the most interpretable solution consistent with the data set. This solution accounted for 51% of the variance; with loadings as depicted in Table 2. While the first factor consisted of 21 items, the second factor was made up 7 items.

Table 2. Factor Loadings of the items

Item No	Factor 1: physical-social	Factor 2: interest-desire
29	.836	
28	.825	
33	.819	
10	.806	
17	.806	
22	.775	
38	.761	
16	.746	
15	.745	
37	.742	
21	.733	
12	.729	
6	.691	
9	.688	
23	.687	
31	.682	
11	.650	
14	.641	
3	.640	
4	.625	
5	.617	
26		.793
25		.714
34		.687
18		.642
24		.579
30		.541
35		.497

The emerged two factors were further labelled as physical-social and interest-desire. Definition of the factors and sample items were depicted in Table 3.

Table 3. Definition of factors

Factors	Label	Definition	Sample Items
Factor 1	physical-social	This factor measured physical characteristics of gender and social consequences of the perceptions regarding ICTs	• Men are more creative • Men are more simple-thinkers • Women are more hypercritical • Men are more successful
Factor 2	interest-desire	This factor measured interest and desire levels of determinants regarding ICTs	• Men have more leisure time • Men use technology more accurate. • Men's technology will follow more.

3.2. Group Comparisons

Firstly, independent samples t-test was used to determine whether there was a significant difference between male and female in relation to the factors. Analyses indicated that there is significant difference among two factors in associated to genders. While the magnitude of the differences in the means for

physical – social factor (eta-squared = .37) is large, it is very small for interest-desire factor (eta-squared = .05).

Table 4. Differences between genders in relation to factors

Factor	Gender	N	M	SD	*t*	*p*
physical-social	Female	40	2,05	0,66	10,356	.000
	Male	142	3,41	0,75		
interest-desire	Female	40	4,02	0,89	3,209	.002
	Male	142	3,58	0,74		

Secondly, the differences in perspectives between departments in relation to two factors were statistically analyzed by one-way analysis of variances (ANOVA) test. According to the values in Table 5, there was not a statistically significant difference at the $p<.05$ level in factors for the departments.

Table 5. Differences between departments in relation to factors

Factors	Computer Engineering		Mechatronics		Industrial Engineering		Civil engineering		ANOVA	
	M	SD	M	SD	M	SD	M	SD	F	*p*
physical-social	2.96	0,95	3,37	0,81	3,31	0,80	3,16	0,95	1,84	.141
interest-desire	3,76	0,76	3,61	0,98	3,89	0,51	3,44	0,80	2,29	.080

Thirdly, the differences in perspectives between students' grade levels in relation to two factors were statistically analyzed by one-way analysis of variances (ANOVA) test. Table 6 below indicates that there was not a significant difference between grades student registered for the factors.

Table 6. Differences between grades in relation to factors

Factors	1st grade		2nd grade		3rd grade		4th grade		ANOVA	
	M	SD	M	SD	M	SD	M	SD	F	*p*
physical-social	3,11	0,96	3,24	0,90	2,89	1,03	3,14	0,84	1,09	.353
interest-desire	3,80	0,74	3,54	0,74	3,51	0,88	3,85	0,78	2,31	.077

Lastly, in order to determine there was a significant difference between students' family culture in relation to factors, one-way analysis of variances (ANOVA) test was run, and the groups were compared. According to the values in Table 7, there was not a statistically significant difference at the $p<.05$ level in factors for the family culture.

Table 7. Differences between family cultures in relation to factors

Factors	Liberal		Democrat		Conservative		Modern		Others		ANOVA	
	M	SD	M	SD	M	SD	M	SD	M	SD	F	*p*
physical-social	2,91	0,78	2,94	0,98	3,28	0,85	2,96	0,87	3,14	1,32	1,40	.234
interest-desire	3,40	0,43	3,45	0,97	3,65	0,71	3,84	0,82	3,97	0,61	1,76	.137

4. Discussion

Many national and international organizations (such United Nation and European Union) report their concerns about under-representation and lower-employment of women in science and technology fields (Mendick & Moreau, 2013). Under-representation of women in ICT sector (especially in engineering) also reflects on number of female students in engineering departments. This situation also projects on this study where number of female students is lower than male students. Therefore, it was difficult to dig into their perception of gender regarding to engineering. It seems clear that female students need more motivation toward registering engineering departments which require destroying stereotypes and prejudices toward ICT sector.

If we want to overcome the issues (especially stereotypes, employment inequality and digital divide) regarding to women in ICT sector, we definitely need a cultural / organizational change aiming new policies and understanding. This need has been also confirmed in our study that one of the contributing factor was related to social aspect of the perception. Therefore, regulating new laws or implementing women quotas at work might only affect women as a quantity whereas revolution wise changes in policies offering better psychological and physical circumstances for women will overtly affect women qualitatively.

Another recommendation is, ICT sector needs more women stakeholders, in the form of managers or executor, who will serve as a model for women as counter-examples toward stereotypes and will guide more and more women employment in ICT sector. In other word, women decision makers will open more gates for other women which will alter the common codes of organizational culture – at least, they may offer a chance to create interest or desire pointed out in this study that such initiatives are one of the major factor for this issue.

Although Bucak and Kadirgan (2011) identified family as a major factor for choosing a department in university, this study revealed that family culture does not make any significant factor in the gender based perception of engineering. Researchers believe that family could be a factor for gender based choosing engineering as a profession with a moderation of different variables such as family socio economic status or educational background. In that manner, further studies must be implemented to comprehend family variable.

It is important to realize that the voluntarily participated and limited sample was not the representative of any larger population of entire engineering students in higher education. Hence, the results cannot be generalized to other situations. The validity of the study is limited to the reliability of the instrument developed by the researchers and honesty of the study participants' answers. Therefore, the study should be duplicated with different and broad samples.

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