

## Technology education and gender: choices and challenges

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**ABSTRACT:** In the 21<sup>st</sup> Century, women remain underrepresented in non-traditional technical professions for their gender. The recent global recession and economic crisis created additional obstacles, which appear to have a deterring effect on female students when choosing technical professions. Statistical data for years 2009-2013 derived from Piraeus University of Applied Sciences (Technological Education Institute of Piraeus) (TEI Piraeus), Piraeus-Athens, Greece, and for 2010-2014 from the Technological Educational Institute of Athens (TEI of Athens), Athens, Greece, illustrate the gender differences in choosing studies and professions, with women opting more often for non-technical courses. One example is the School of Business and Economics at the TEI of Piraeus where the representation of female students was quite significant during the examined years, while in the Faculty of Engineering the proportion of female students was rather restricted. Is this an unpleasant impact of the global economic crisis on the educational choices of Greek students or is it the gender difference that leads women to other academic orientations and professions?

### INTRODUCTION

In defiance of the tremendous benefits women have gained in education over recent decades, technology still remains a non-preferred field for girls, even if it is not unapproachable. Whilst women make up to 40 percent of the global workforce and have come a long way in breaking cultural stereotypes and barriers, there remains a widespread gender imbalance in engineering-related studies and businesses in the United States and Europe.

In recent years, in the increasingly competitive global economy, the factors that create real barriers to student participation in fields that are non-traditional for their gender cannot be ignored [1]. Several social statistics indicate that the choice of disciplines is mirroring the gender discrimination, leading to the continuity of traditionally *male* and *female* professions.

Whereas there are no overt gender issues, gender appears progressively as an important parameter to be taken into account, regarding access to technological education, as well the labour market opportunities for girls and women [2]. Stereotypes act as barriers to the study, recruitment and promotion of women in both academic and professional science and engineering fields.

### TECHNOLOGY EDUCATION AND GENDER: CHOICES AND CHALLENGES

Gender issues have been widely discussed over the years. Despite women's gains in non-traditional fields as a whole, the rate of female enrolment in certain technical career clusters remains at stubbornly low levels [3]. Though female students continue to be the vast majority among freshmen enrolling in what are considered to be female education courses (such as cosmetology, child care and health services) and even in the less feminised faculties of the technological educational institutions in Greece, such as business administration and accounting, this is not the case for faculties of engineering and mechanics.

Statistical information provides ample evidence for the gender imbalance and a ground for assumptions that gender differences, stereotypical prejudice, male domination, as well as possible future perspectives in labour market, discourage young girls from undertaking technical studies. Women seem to have a stronger affinity with societal issues than men, and an attitude that leads them to faculties of social and health studies. So, although they are satisfactorily represented in professions, they still remain sorely underrepresented in non-traditional, for their gender, technical professions [4]. Consequently, attracting them to those careers remains a challenge for technological institutions globally and in Greece. Segregation and inequality seem to be the disappointing reality, resulting in the deterrence of female students from choosing technical professions.

As it is shown in the following statistical data from years 2008-2012, derived from Piraeus University of Applied Sciences (TEI of Piraeus), in both the departments of the School of Business and Economics; namely, Accounting and Finance, and Business and Administration, considered as the fields with theoretical orientation amongst the purely technological disciplines, the representation of women is quite significant [5].

In Table 1, one can see the number of female students in the Department of Accounting and Finance between 2008 and 2012, and Table 2 shows the number of female students in the Department of Business and Administration. It can be noticed that women comprise approximately half of all *freshmen* across these two departments.

Table 1: Total enrolment and female students in the Department of Accounting and Finance, 2008-2012.

Department of Accounting and Finance			
Year	Total number of students	Female students	% of female students
2008	470	254	54.0%
2009	423	208	49.2%
2010	310	129	41.6%
2011	230	111	48.3%
2012	185	75	40.5%

Table 2: Total enrolment and female students in the Department of Business and Administration, 2008-2012.

Department of Business and Administration			
Year	Total number of students	Female students	% of female students
2008	185	94	50.8%
2009	170	87	51.2%
2010	207	110	53.1%
2011	158	91	57.6%
2012	155	75	48.4%

Also, female presence in the Department of Civil Engineering can be regarded as non-negligible. As one can see in Table 3, during the quinquennium 2008-2012, female *freshmen* were represented as a considerable percentage.

Table 3: Total enrolment and female students in the Department of Civil Engineering, 2008-2012.

Department of Civil Engineering			
Year	Total number of students	Female students	% of female students
2008	177	59	33.3%
2009	191	78	40.8%
2010	224	85	37.9%
2011	148	71	48.0%
2012	137	57	41.6%

Unfortunately, the situation is quite different in the traditionally male-oriented disciplines of automation, electrical and mechanical engineering, where only a small proportion of students are women. The data in Tables 4-6 indicate that technology education over 2008-2012 was rather challenging for women, leading them to other orientations and professions.

Table 4: Total enrolment and female students in the Department of Automation Engineering, 2008-2012.

Department of Automation Engineering			
Year	Total number of students	Female students	% of female students
2008	135	17	12.6%
2009	186	17	9.1%
2010	169	16	9.5%
2011	150	23	15.3%
2012	124	13	10.5%

Table 5: Total enrolment and female students in the Department of Electrical Engineering, 2008-2012.

Department of Electrical Engineering			
Year	Total number of students	Female students	% of female students
2008	143	21	14.7%
2009	144	11	7.6%
2010	210	21	10.0%
2011	161	22	13.7%
2012	130	18	13.8%

Table 6: Total enrolment and female students in the Department of Mechanical Engineering, 2008-2012.

Department of Mechanical Engineering			
Year	Total number of students	Female students	% of female students
2008	219	28	12.8%
2009	219	20	9.1%
2010	207	13	6.3%
2011	170	9	5.3%
2012	138	13	9.4%

As the percentage of female students in the three departments presented above is strikingly low, the question arises of whether this is due to certain socio-cultural factors or if the low numbers reflect also the unpleasant impact of the global financial crisis on the educational system and, furthermore, on the choices of female students? The financial collapse seems to accelerate a general reduction in the number of women, who might potentially choose technological studies and, hence, technical professions. However, it is not clear enough, whether this is related predominantly to the crisis or it is a proof of gender imbalance, choices, challenges and perspectives, over the years.

To reinforce the point of view that female students have been poorly represented in technological education over the last years, statistical data from selected schools of the Technological Educational Institute of Athens (TEI of Athens) have also been examined [6]. In regard to the TEI of Athens, this research has proceeded further, covering years 2010-2014. The examined statistics prove the shift in female thinking and choosing in regard to technological education, as there was a significant reduction in the percentage of female students per department between years 2010-2014. In Tables 7-8, it is shown that in purely technical disciplines, such as electronic engineering and naval architecture, women were quite underrepresented.

Table 7: Total enrolment and female students in the Department of Electronic Engineering, 2010-2014.

Department of Electronic Engineering			
Year	Total number of students	Female students	% of female students
2010	137	14	10.2%
2011	107	11	10.3%
2012	106	11	10.4%
2013	134	13	9.7%
2014	126	8	6.3%

Table 8: Total enrolment and female students in the Department of Naval Architecture, 2010-2014.

Department of Naval Architecture			
Year	Total number of students	Female students	% of female students
2010	83	18	21.7%
2011	95	22	23.2%
2012	97	26	26.8%
2013	110	21	19.1%
2014	106	21	19.8%

The situation does not seem to be improved in the examples included in Tables 9-10 and regarding energy technology engineering and biomedical engineering, the two disciplines related to internationally established and rapidly evolving fields. It would normally be expected that a higher percentage of female students enroll and attend these schools that

offer studies of promising perspective for the future in the labor market. Unfortunately, also in this case, the numbers remain disappointing.

Table 9: Total enrolment and female students in the Department of Energy Technology Engineering, 2010-2014.

Department of Energy Technology Engineering			
Year	Total number of students	Female students	% of female students
2010	98	8	8.2%
2011	101	6	5.9%
2012	110	19	17.3%
2013	109	22	20.2%
2014	100	14	14.0%

Table 10: Total enrolment and female students in the Department of Biomedical Engineering, 2010-2014.

Department of Biomedical Engineering			
Year	Total number of students	Female students	% of female students
2010	94	20	21.3%
2011	100	23	23.0%
2012	107	29	27.1%
2013	118	35	29.7%
2014	118	34	28.8%

Subsequently, when reviewing the figures from the Department of Library and Information Systems, as well as the Department of Business Administration of the TEI of Athens, depicted in Tables 11-12, one can assume that female students continue to show strong interest in other than technical disciplines, despite the crisis.

Table 11: Total enrolment and female students in the Department of Library and Information Systems, 2010-2014.

Department of Library and Information Systems			
Year	Total number of students	Female students	% of female students
2010	90	73	81.1%
2011	96	66	68.8%
2012	103	73	70.9%
2013	121	84	69.4%
2014	109	77	70.6%

Table 12: Total enrolment and number of female students in the Department of Business Administration, 2010-2014.

Department of Business Administration			
Year	Total number of students	Female students	% of female students
2010	444	247	55.6%
2011	355	187	52.7%
2012	325	186	57.2%
2013	401	207	51.6%
2014	390	228	58.5%

The data presented in the two tables above reinforce the notion that young female students select at a lesser extent professions related to technical education, believing probably that the labor market during recession, will be limited for them, if they turn to technical professions.

## CONCLUSIONS

In the past five years, the international financial system has been affected by a serious crisis. A number of countries have declared that they are in recession and are experiencing increasingly negative effects in technical professions, accompanied by a change in human attitudes and choices. This economic downturn is likely to have a different impact on men and women and their integration into the labour market, especially, since the construction and manufacturing sectors have always been male-dominated.

Based on the examined data, it would appear that women acknowledge this fact and facing the probability of being unemployed after having finished their studies, mostly because men are usually being given the priority in undertaking operations of technical nature - especially, during this period of recession that few works still occur - they avoid technological education.

Women need to feel secure as students and as professionals in order to choose and attend technical disciplines. The mission of technological educational institutions should be primarily to provide them with the required environment of balance and equality between male and female students and, secondly, to facilitate the acquisition of knowledge, the recruitment and retention of women in relevant to their studies and professions.

By eliminating any obstacles of the so-called male-domination, by extirpating deeply ingrained cognitive biases that used to rig the game in favour of men, by inspiring both women and men to work collectively, by making them realise that diversity in a team could become its strength and by envisioning a vibrant community, which uses positively and equally their talents, expertise, experiences and ideas, technological education in the 21st Century will not remain a male dominated field and women will not still be under-represented in it, regardless of economic crisis or not.

Technical schools should promote the presence of women, as women in technology and engineering can contribute their intuitive skills, suggest, share and implement innovative ideas into technical sciences and professions, in order to have a real and essential impact on everyday life [7].

Notwithstanding any of the above conclusions, it has to be acknowledged that further investigation into women's professional opportunities and choices during the current economic downturn is required to provide a truly comprehensive explanation of the statistical data collected for the current study.

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