Using Virtual Classroom Technology to Promote Equal Opportunities for Post-Graduate Women Engineering Students

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Abstract

The traditional role of a university is to provide learning opportunities, mainly for students from 18-25 years of age, and to offer an education relevant to meeting life's challenges. Beyond that, post-graduate studies serve as the first stage in continuous, lifelong adult education. More attention should be paid not only to enhancing the educational curriculum, but also to improving the manner in which it is being taught and the means of its delivery.
In the engineering sciences curriculum, where the learning material is subject to frequent, significant changes, this poses an especially acute problem. These constant changes cause differences in the levels of "starting knowledge" not only between young and adult students, but also between mature men and women students, due to the disparity in martial and parental status, educational aspirations, etc. [1]. Many potential women graduate students feel that, as a result of their having left their university studies to fulfill traditional family obligations, they later find themselves at a disadvantage in comparison with men graduate students.
This work offers a practical means for surmounting the gender bias in "starting knowledge" for many graduate engineering courses and possibly other courses, as well. We propose the use of modern learning technologies (such as E-learning) and changes in the existing methodology of some courses to reflect gender demands in E-learning [2].
We explore an approach based on dividing the learning materials into two modules.
***Module 1** brings all the students up to the same level of "starting knowledge"; it is totally interactive, done by means of fully virtual lessons (including conversational audio, live video, animation) with online tests, practice exercises and final examinations.*
***Module 2** combines frontal classroom lectures and online chats, forums, bulletin boards and polls.*
Submission of a research project is required at the end of the course to complete the course requirements.
An analysis of some course statistics demonstrates that mature women students, in particular, prefer and do better in courses designed according to the approach proposed above. Our proposed method is universal and may be implemented in any compatible E-learning course.

1. Why is female post-graduate engineering education so important? Some facts.

In light of the position held by Science, Technology, Engineering and Mathematics (STEM) in the development of modern society, the governments of many nations support efforts to stimulate educational progress in all STEM fields. However, when comparing the number of Bachelor's students by scientific fields (Figure 1), one can see that the number of women students in the Engineering Sciences (ES) is approximately 75% less than that of their male counterparts. An analogous disproportion also appears in the number of Master's and Doctoral students (Table 1).

Clearly, this suggests the need for more rigorous evaluation of the factors leading to this situation. It is crucial to note, however, that Bachelor's students are a more homogenous group than their post-graduate equivalents in regard to gender and other characteristics, such as: age, work experience, motivation, family status, etc. For example, Figure 2 illustrates the difference between male and female ES Master's students (with and without working experience) who have chosen to resume their graduate education after several years of absence.

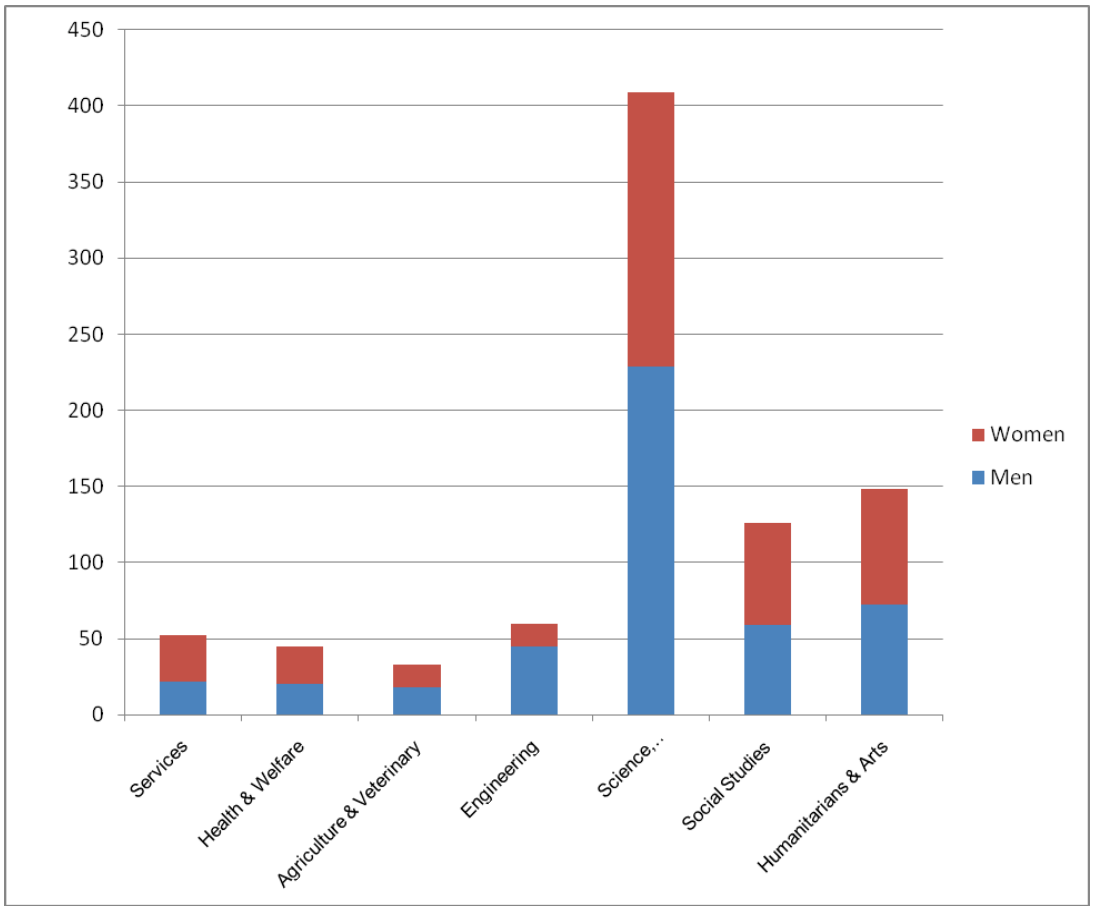


Figure.1 Distribution of Bachelor's Degree Students in Israel by Field [3]

Table 1. Distribution of Students by Faculty and Degree at the Ben-Gurion University of the Negev

School of Management		Health Sciences		Engineering Sciences		Natural Sciences		Humanities & Social Sciences			
Female	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**		
49.9	50.1	70.8	29.2	19.8	81.2	43.0	57.0	65.1		Bachelor's	2002-2003
45.6	54.4	78.7	22.3	20.3	79.7	35.7	64.3	65.4		Master's	
40.2	52.8	56.9	43.1	17.9	72.1	62.0	38.0	60.0		Ph.D.	
49.4	50.6	73.6	26.4	25.0	75.0	40.9	59.1	64.2	35.8	Bachelor's	2005-2006
49.7	50.3	75.5	24.5	23.8	76.2	32.8	67.2	70.9	29.1	Master's	
48.5	51.5	59.1	40.9	26.5	73.5	37.0	63.0	59.4	40.6	Ph.D.	
											2007-2008

54.9	45.1	74.6	25.4	26.0	74.0	44.0	56.0	62.2	37.1	Bachelor's	
51.7	48.3	80.2	19.8	25.6	74.4	36.4	63.6	70.1	28.9	Master's	
48.9	51.1	60.2	39.8	28.5	71.5	41.0	59.0	63.1	36.9	Ph.D.	

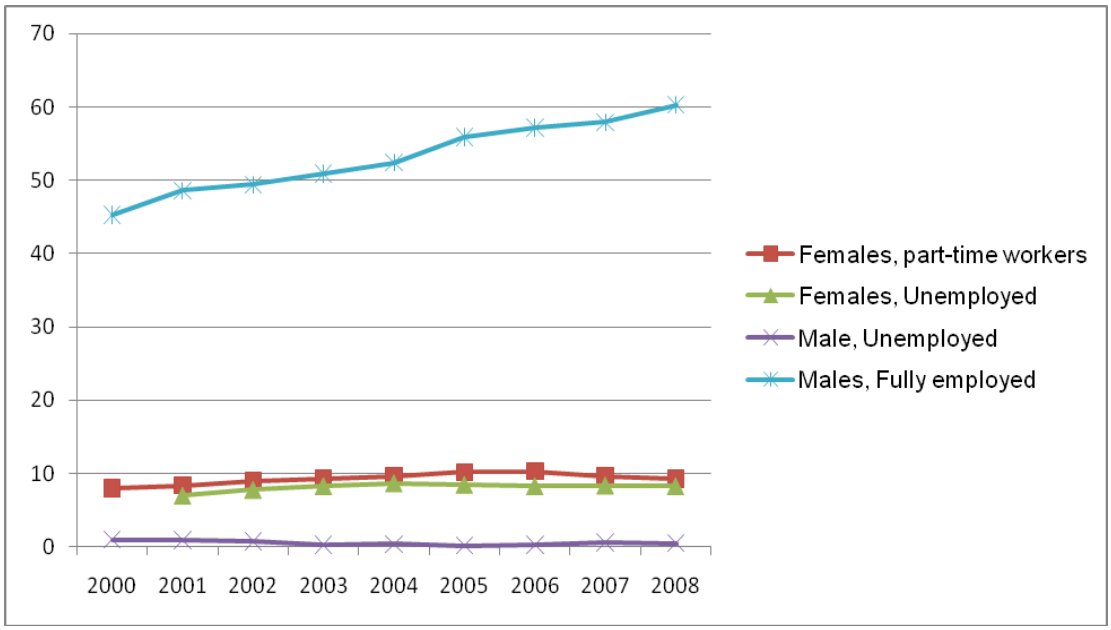


Figure 2. Percentage of ES Master's Degree Applicants following a 3-5 Year Hiatus in Their Higher Education

Many women, who were unemployed during their 3-5 year educational hiatus, plan to use their future Master's degree to attain prerequisite, entry-level job qualifications. However, most men who apply for Master's studies after a 3-5 year educational hiatus were working during that period and do so t further their careers. Thus, it appears those traditional, 'stay-at-home' wives and mothers, or those

holds part-time jobs, are already at a major disadvantage with regard to their male counterparts. In fact, the ES labor market continues to raise its standards and demands, providing even less flexible employment conditions, placing more obstacles in the path of potential women ES graduate students and preventing their number from growing significantly.
Obviously, to raise the number of women graduate students, one has to resolve this complex problem. Our solution includes an important component--the use of modern educational technologies, particularly E-learning.

2. A brief background on existing E-learning systems

Over the past 5 years, E-learning strategies have been incorporated into most of the public higher education programs in the West: more than 75% in the USA universities and 69% in European public universities. It is crucial to emphasize that: "E-learning is a learning process in which learners can communicate with their instructors, and their peers, access the learning material, over Internet or other computer networks"[4].

There are many types of E-learning environments: synchronous and asynchronous, Learning Management Systems (LMS), Content Management Systems (CMS), etc. Commonly, universities use LMS. There are many LMS vendors, such as WebCT, Blackboard, HighLearn, etc.

LMS has various distinct elements:

1. Interaction tools (E-mail, chats, video conferencing, white-boards, etc.).
2. Content delivery (Web-based).
3. Student management (student tracking, assignment control, auto-grading, etc.).
4. Multi-language support.

5. Synchronous and asynchronous “built-in” modules.

Note that very few studies correlate gender and E-learning, especially with regard to graduate studies via LMS. This paper considers utilizing the outstanding capabilities of LMS and to satisfy gender-related demands on E-learning.

3. Gender-related demands on E-learning

In light of prior research [5-11] and to attain the most effective use of LMS, we propose a set of gender-user based demands for E-learning.

1.The Students' Ages

Many researchers state that, in 30-40 year old students who use some kind E-learning environment, the gender difference in Internet usage is about 18% [5], while this difference is only about 2% amongst younger students.

2. The Chosen Discipline

Some recent studies show [6] that disciplines offering E-learning courses motivate more men and women to participate. In disciplines such as computer programming, software usage, etc.), there is only a small gap in gender motivation. One crucial factor, however, is the level of prior knowledge. Student groups with the same previous professional experience show no gender difference when choosing courses.

3. Communication Styles

Communication style is fully gender-dependent. In [8], it was found that there are distinct gendered communication styles in homogeneous male and female groups or in groups having a majority of one gender. Most frequently, the prevailing gender in a specific group determines the preferred communication style. The male communication style in chats, forums and other collaboration tools is more aggressive and competitive, with put-downs, frequent postings and self-promotion. The female style is characterized by 2 aspects: support and attention [9]. Another research showed that the level of anonymity in mailing lists influences the communication style. In [10], it was shown that communication between students who are strangers is more gendered than in groups where people know each other. All of this must be taken into account for the effective application of the LMS.

4. Learning Strategies

There, as yet, are no comprehensive and concrete analyses based on the importance of gender in learning styles. It appears, however, that women seem to prefer cooperating to working alone, unlike men [12]. One study finds that 44% of women students, compared to 24% of men students, opted for group work and interaction.

Our preliminary analysis of gender demands from E-learning indicates their complexity. But even at this point in our study, we understand that any course exploiting a learning environment, such as LMS, to entice women students to register, has to be founded on blended scenarios include of fully virtual and face-to-face modules and collaboration tools. (More detailed analysis of this topic is yet to be done.)

4. Using virtual classroom technology to promote equal opportunities for ES post-graduate women students

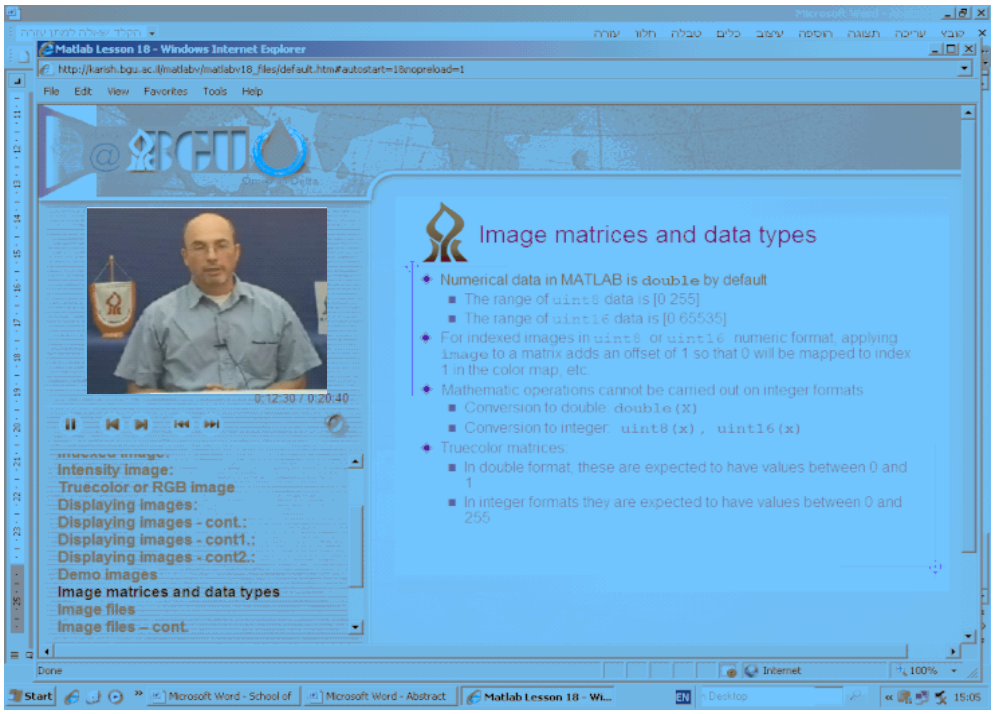
Is this work, therefore, we propose the following graduate course design, applying LMS methodology and dividing the course materials into 2 modules:

Module 1 – brings all the students up to the same level of "starting knowledge", which is very important for mature working-women students.

Module 2 – provides a mixed-initiative dialog, which combines frontal classroom lectures and on-line forums, chats, bulletin boards and polls.

To illustrate our novel approach, we analyze the outcomes of an LMS course "Using MATLAB software for engineers". For the last 4 years, this has been a required course for students of all degrees

at the Ben-Gurion University of the Negev Faculty of Engineering Sciences. This course was designed in High Learn LMS by Britannica Knowledge System, Ltd.
It is a special course, because the learning material bears no direct connection to previous knowledge in mathematics, physics, etc. It may pose some difficulty to mature post-graduate students.
As describe above, Module 1 of the course allows all the students to reach the same level of "starting knowledge". This is accomplished by means of fully virtual lessons, provided by a (didactic and professional) specialist in this field (Figure 3).



A Lesson Fragment. **Figure 3.**

Each lesson includes conversational audio, video, 3D graphics, live animations, etc.
After each subject is taught, there are relevant assignments (Figure 4) and on-line quizzes. At this stage of learning, there is only one frontal, introductory lecture.

Module 2 of the course, besides the traditional frontal- lectures, offers participation in classroom discussions and the preparation of a research project, to be done, perhaps, in small teams or study groups with a balanced male-female ratio (in compliance with the gender demands above in 3.4).

5. Results

To evaluate the effectiveness of our proposed method, we compare the results of teaching said course in two different groups of students:

First Group(FG)--Bachelor's students, instructed using the customary methodology, including once-a-week lectures with the course curriculum presented via Power Point presentations, .doc files, all displayed using the same HighLearn system. Some of the assignments were preferred to be completed online and others to be done as laboratory work in the classroom. The exchanging of FAQs, discussions on solving homework problems, etc., was all carried out in online forums. The final exam and course summation was held in the classroom.

The Second Group(SG)—Master's students, for whom an integrated course was designed according to our suggested method.
The male-female ratio in the FG group was 69%-31% and in the SG group it was 65%-35%.

Age, employment status and parental status were not taken into account.
In both cases, the statistics were compiled using HighLearn System Management reports, such as: "Viewed Items report", "Assignment Status report", "Activity report", etc.

Table 2. Percentage of Logins Per Group

	First Group	Second Group
Men	49.5%	46.8%
Women	50.5%	53.2%

This Table shows that the amount of logins to the Course Library tree is almost identical for men and women from the First Group. Moreover, according to the "Activity report", all of these logins occurred during the first weeks of the course and did not reoccur.

On the contrary, analysis of the Second Group attests to the fact that the existence of the audio/video components replaced the need for actual attendance at frontal lectures. As a result, students are motivated to review the course material many times. This positive aspect encourages more students register for such a course.

Let us examine how these outcomes relate to the grading of assignments.

Table 3. Grades vs. Assignments

	Assignment 1	Assignment 2	Exam	Research Project
Women- FG	60.3	65.5	68.3	-
Men- FG	59.7	60.5	68.7	-
Women- SG	68.7	69.4		76
Men- SG	64.1	68.1		72

In this tally, we see that women, on average, tend to get better grades on their assignments than men do. However, on the final exam, men tend to show slightly better marks. This may occur due to the fact that men are generally over-confident, leaving the completion of their assignments to the last minute, thus lowering their scores. In contrast, women generally tend to complete all their assignments on time. In addition, in accordance with studies mentioned above, we deduce that women will score higher than men in the research project, since such a project requires high-level team work and communication skills.
The outcomes of the exemplary course above do, indeed, indicate the veracity of our approach; the SG women in the course produced better research projects, than the weaker exam results attained by the FG women. We also discovered, by means of taking online polls, that 70% of these women students exhibited higher satisfaction with our adapted LMS course format than with the traditional one.
This may be explained by a myriad of factors. Firstly, the presence of fully online virtual lessons allows mature women students with families and work commitments to make progress in their studies without having to actually come to the Campus and to review the material at their convenience.

6. Conclusions

This work is only a first step in researching the connection between gender considerations and modern learning environments. We have shown that the proposed approach, of dividing courses into two modules: 1) bringing all the students to the same level of "starting knowledge" and 2) combining frontal presentations and face-to-face meetings with online access, increases the likelihood that graduate students, and especially mature women graduate students will choose such a course over the traditionally-formatted ones. The results of this investigation provide a method for equalizing education opportunities. This responds not only to the question: "Which students of the engineering sciences are most successful as end-user E-learners?", but also facilitates the effective transfer of necessary knowledge to all the course-participants, whatever their gender, age, socio-economic standing, previous work experience, etc., may be.
We further suggest that our modular course format, being universal in nature, may be compatible and implemented to a great benefit in E-learning courses on all levels of higher educations in all the other

disciplines, as well. We recommend that it be adopted by schools of continuous adult education, toward the more effective promotion of lifelong learning. Again, we consider this work to be merely the starting shot, setting off extended future research, which should include in depth psychological, pedagogical and social studies on gender issues, E-learning techniques and equalization in higher education.

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