Breaking gender stereotypes in technology education: Developing strategies in the English classroom

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Abstract

Recent research on gender issues has highlighted the scarcity of women in technology education. The need to close the gender gap in these university studies has been addressed by administrations and professionals in the field. In this line, this article presents the results of a project carried out in two learning environments: a university ESP course and a general English language class in secondary education. First, in order to observe gender bias, a discourse analysis of textbooks for English as a Foreign Language (EFL) was undertaken, focusing on the specific topics of science and technology to observe the representation of women and sexist language in written discourse. Then, as a speaking exercise, some simulation activities were devised and carried out in the English class aiming at helping students to be aware of gender imbalance in the field of technology. These activities gave rise to a discussion on gender stereotypes in the media as well. The article concludes with the educational value of these learning strategies and their implications for society. The debriefing sessions carried out suggest that the project has served to motivate learners of English and has promoted gender bias awareness in different branches of engineering. The novelty of the project consists in interacting language skills, mainly speaking, with strategies developed to promote the incorporation of females in higher technological education, both in an ESP university course and in secondary education.

Keywords: ELT, ESP, technology education, simulation, gender discrimination.

1. Context: new challenges in language teaching and technological degrees

1.1 The Common European Framework of Reference for Languages (CEFR)

Teaching languages in Europe has developed a profound process of standardization in the last few years due to the incorporation of The Common European Framework of Reference for Languages (CEFR) in secondary and higher education throughout European education centres. For several European languages, the Framework defines levels of proficiency which permit to measure learners' progress at each stage of learning on a life-long basis. Thus, progress in language learning is calibrated according to six levels of attainment, which range from A1 to C2, being A1 the lowest level of attainment. These days, the Framework is

gaining importance as it has been recommended in setting up the reforms in secondary and higher education systems throughout Europe, which try to make academic degree standards and quality assurance standards more comparable and compatible throughout Europe (Pérez-Sabater, 2012).

Apart from linguistic competences, the CEFR promotes non-language-specific competences such as sociocultural knowledge and pragmatic competences. As for sociocultural knowledge, that is, the knowledge of the society and culture of the community or communities in which a language is spoken, the CEFR proposes that it merits special attention since "unlike many other aspects of knowledge it [sociocultural knowledge] is likely to lie outside the learner's previous experience and may well be distorted by stereotypes" (CEFR, 2001: 102). The features characteristic of a society and its culture may include, among others, interpersonal relations between sexes.

1.2 Technology education and gender imbalance

Women have gained representation in many spheres of society during the second half of the XX century, at least in the developed Western countries, although unevenly even within these regions. Despite the tremendous gains that females have made in education and the labour market during the past 50 years, "progress has been uneven, and certain scientific and engineering disciplines remain overwhelmingly male" (Hill, Corbett & St Rose, 2010:2). The gender gap in scientific and technological education is a problem that educational administrators have been facing all over the world (see, for example, Mayer-Smith, Pedrettib & Woodrowa, 2000; Crombie, Abarbanel & Anderson, 2010). In higher education, the underrepresentation of women in science, engineering and technology has been the source of important research over the last decades, with the publication of significant studies that tackle this issue[1] (Cronin & Roger, 1999). Moreover, research underlines the outstanding underrepresentation of women in Information and Communication studies all over the world (Sanders, 2005), in spite of the growing importance of technology and computers these days. In Western countries, governments are campaigning against the low numbers of women in computing and information technology: see for the USA the National Center for Women in Information Technology (http://www.ncwit.org/about.factsheet.htm). As for Europe, in 2009 The European Directory of Women and ICT was created under the initiatives of the European Commission aiming at significantly increasing the number of girls and women into the technology sector.

In The Universitat Politècnica de València (UPV), a university dedicated to engineering studies, only 33,6% of students are females in all the branches of engineering, in computing a very poor 11,4% of the students are girls. Due to these low numbers of female involvement, the UPV has been carrying out strategies to attract female students in high schools for the last years as well. Among others, these initiatives include a play where a girl wants to study a scientific degree, a television comedy in which a group of 5 girls get the challenge of studying a technical degree, choosing the hardest road http://www.valentinas.upv.es/. In parallel, the School of Computing is also campaigning hard to close the gender gap and enhance the participation of females in the computing field, promoting these studies in secondary education. The School regularly organises talks in high schools and events such as "Bits in Feminine, Women in Computing", a meeting of female professionals and educators to this end.

[1] As for the reasons for the absence of women in these fields, there have been many explanations put forth in the literature of the last 30 years (Hill, Corbett & St Rose, 2010). Nevertheless, this paper will deal with initiatives to palliate gender imbalance, we will leave the proposal of explanations to other approaches.

Education may reinforce or question stereotypes (Clayton, von Hellens & Nielsen, 2009). In this context, this research tries to challenge situations that may involve gender bias, it presents the results and implications of a project carried out in a Spanish learning environment, in a subject calibrated to the CEFR. However, the implications of the project undertaken can address the problem of gender imbalance and gender stereotypes in learning contexts worldwide. The project developed in this article consists of a discourse analysis of EFL textbooks, some simulation activities devised and carried out in the English class, and a follow up study of gender stereotypes in the media. The purpose of these activities is to approach gender imbalance in technological environments and to promote the incorporation of females into technical degrees in the language class while developing speaking skills in English. Finally, the implications of the project on an ESP course and a general EFL course will be discussed and compared.

2. Language, sexism and EFL textbooks

2.1 Language and sexism

In sociolinguistic studies, some feminists like Frank (1989) or Spender (1998) have concluded that our languages are sexist. In their opinion, they represent or 'name' the world from a masculine viewpoint and in accordance with stereotyped beliefs about women, men and the relationship between them. Linguistic representation is not a neutral and transparent means of representing reality, but androcentric. There is a biased representation of the sexes in language. The bias concerns the portrayal of men as the norm and women as the appendage or as the exception in language. Linguistically speaking, males appear as non-gendered or generic subjects, but women, on the other hand, seldom do. As for Cameron (1998) what is sexist is how certain linguistic subsystems represent gender: generic masculine pronouns, feminine suffixes, etc. Nevertheless, for López & Morant (1995) language cannot be inherently sexist because it is an instrument to express thoughts, not an ideology. The problem is that men have power over women and this supremacy is reflected on language. Sunderland (2002:2) underlines that this brings us to a difficult issue, "if society is imbalanced, should textbooks represent society?"

In this debate about prescriptive or descriptive positions in language and language teaching, we will observe the representation of women in the EFL textbooks we use for the level B1, that is, low intermediate according to the European Framework, having a special regard to the topics that deal with science and technology.

3. EFL textbooks

The analysis of language materials and the portrayal of sexes have a long history in language learning and teaching research. In their seminal study, Hartman and Judd (1978) observed that women were less visible than men in textbooks, by studying both the linguistic and the visual content of the learning materials. More than 30 years later, the results of the linguistic and visual analysis carried out on 5 units of 2 textbook materials calibrated to the level B1, that is, low intermediate according to the CEFR, may still be of interest. The textbooks studied are the following:

Language Leader Intermediate, 2008. Harlow: Pearson Education.

Get it Right 2, 2008. Oxford: Oxford University Press.

Language Leader is the main resource employed in the ESP course together with some dedicated materials developed by the teachers. This coursebook was chosen not only because it is calibrated to the level required by the university, but also because, although it follows a general English approach, some units lend weight to an ESP approach for adult learners with specific topics such as Work, Business or Engineering.

A representative example of the textbooks analysed is shown below.

The results of the analysis shown in Tables 1, 2, and 3 demonstrate that authors and publishers have made a great effort to combat sexism in language teaching in the new materials calibrated to the levels of the European Framework.

3.1 Visual content

Year of publication	Women	Men	Women & Men	Non personal
2008	25%	28%	30%	17%

Table 1. Visual images (drawings and photographs)

Women are portrayed as principals, engineers and journalists, whereas men are designers and builders.

3.2 Linguistic content

Year of publication	Female	Male
2008	55%	45%

Table 2. Female and male subjects/objects in examples

Year of publication	Women	Men	Women & Men	Non personal
2008	27%	26%	35%	12%

Table 3. Men versus women mentioned in texts

In the textbooks studied, stories about women are as frequent as the ones with a male character and some reading activities promote a debate about the role of women engineers or single-sex schools. We usually find people with a name and no title such as *Marie Laforet*; in just a few situations we find a title like a teacher called *Mr Jones* and a customer *Mrs Daley*. As for the presentation of pronouns and generic pronouns and terms, *people* and *everyone* are the most frequently used subjects for generalization. In a few examples, *he* and *his* are used to refer to a supplier, the editor of a newspaper is addressed as *Dear Sir*, the principal of a university is a woman and a professor is named *Hilary*. Furthermore, the generic terms are of the type *salesperson* or *working person*.

To sum up, we could even suggest that, in some cases, the authors of the coursebooks published in 2008 have applied positive discrimination strategies in the elaboration of the

learning materials, promoting discussions about gender issues. As an example, in one of the units with a profound ESP orientation in *Language Leader*: unit 9 Engineering, the introductory reading exercise has a female engineer as the subject of both the reading and the listening exercise. In other units, the principal of the university is a woman, one of the greatest explorers chosen is also a woman, and a space pioneer reading exercise is about the first woman in space.

4. Activities developed

The discourse analysis carried out implies that the present materials for language teaching and learning try to follow a prescriptive approach to society with no discrimination against women. However, statistics do show women bias in society and in the labour market (Spanish National Institute of Statistics, 2011). Strategies are, thus, needed to deal with this situation, especially with the imbalance of women in the technical field, our major concern.

According to Norton and Pavlenko (2004) there are several ways how teachers can address gender in the classroom: curricular innovations, feminist teaching practices, classroom management and decision-making practices, and topic management. From these, we will adopt what Norton and Pavlenko denominate topic management, a way which promotes critical reflection by incorporating gender issues into already existing classes.

In this regard, some activities were developed to promote discussion while serving as a speaking exercise in the language class. This could be the right context in which games can be adopted in the classroom, a difficult issue for teachers according to Hsu & Wang (2010).

The use of simulations and role playing is of long tradition in communicative language learning (see, for example, Tompkins, 1998). By means of simulations, languages can be practised in a nonthreatening context enhancing motivation and involvement needed for learning to occur (Tompkins, 1998). Besides, simulations can help students to communicate in purposeful ways and about meaningful topics, sharing and obtaining information and accomplishing "real-world" transactions (Richards, 2008). Tompkins (1989) suggests that a simulation can be rewarding to students and teachers if it is integrated with other language learning activities. In ESP courses, the inclusion of simulations has a long tradition since they can be particularly interesting because "games can be loaded with the subject area of the ESP course" (Crookall, 1984: 267).

Relatedly, the Framework recommends the use of simulations as communicative strategies for language learning. They can be the platform where the practice of the spoken language has, then, a purpose. In this way, simulations can motivate students in achieving more fluency in English, an ever growing need these days, due to the role of English as the international language (Richards, 2008). Furthermore, it seems that learners value their mastery of speaking skills in English as a priority in their learning process (Richards, 2008). In the Framework, speaking skills are also considered important and "social value is attached to them" (CEFR: 14).

On the other hand, the Framework also recommends simulations to treat the non-language-specific competences in language courses, such as sociocultural knowledge and pragmatic competences.

In this context, the simulations and role plays we present were devised to practise speaking in the English class while reinforcing the non-sexist approach observed in the learning materials and promoting technical studies in female high school students. These activities were carried out in a high school English class and a university ESP class. Both groups of

participants registered in a B1 level English class although they belonged to two different groups: high school students and university students.

The activities described below took place in the following learning environment:

Classroom A: English class, level B1 (lower Intermediate CEFR), 32 high school students, 16 boys and 18 girls aged 17 or 18. 30 students born in Spain, 1 student from Estonia. They were in their last year of high school, the year prior to university.

Classroom B: English class, level B1 (lower Intermediate CEFR), 35 university students of English for computer engineering. They were in their second year and it was the first year they were learning English at university. 32 boys, 3 girls. 32 Spanish students, 2 boys from the Czech Republic, 1 girl from Turkey.

These groups were chosen because the sample reflects the current cultural and linguistic diversity of education in Spain: the first students from an immigrant origin arriving at high school and university, and a high percentage of Erasmus students per class in tertiary education, a culturally heterogeneous learning environment similar to universities worldwide (Kim, 2008) and education institutions. On the other hand, these classroom profiles are similar to previous courses and the results could be extrapolated to them and to future learning environments (Pérez-Sabater & Montero-Fleta, 2012).

Finally, we would like to point out that, as detailed below, Activity 1 took place in both contexts, in a university and a high school English language learning course. Activity 2 was only carried out in the university ESP course.

Scenario

The School of Computing is trying to enhance the incorporation of female students into the field of computing. To this end, some strategies have been developed recently in high schools and in the School of Computing. In this context, the activities we are presenting have been devised to promote technical studies in secondary students and to encourage a non-sexist approach in engineering. Students have seen the topic *Engineering* in the English as a foreign language class. They have learned new vocabulary, read texts and listened to conversations about engineering and technology. The objective of this simulation is twofold: to address the problem of gender imbalance in technology education and to develop language skills in English for Specific Purposes such as vocabulary acquisition, writing and speaking skills.

4.1 Activity 1: Famous engineer

The exercise consists in students acting as journalists and professionals in the engineering world.

Background

In both schools, that is, secondary and university, students have seen the topic *Engineering* in class. They have learned new vocabulary about the topic. Therefore, sufficient information is provided on the issue.

In class, the teacher reviews the vocabulary related to each topic before the small simulation activity starts.

Participants are provided with a profile sheet.

Situation

A famous engineer is coming to the school next week. This person has developed rechargeable batteries which hold their charge for many months and can be used with computers and mobile phones. You are a journalist who wants to write an article for a famous magazine about this person.

Objective

To interest female students in the engineering field and to show that engineering is not a man's world.

Profiles

Journalists, famous engineer.

Time

Background study: 10 minutes; action 20/30 minutes.

Level

B1 or lower intermediate.

4.1.2 Profiles

Profile 1: Journalist A

You are a journalist who is going to interview a famous engineer next week. This engineer is a prominent person but very inaccessible. Due to the innovative and profitable discoveries, this person is now in the media but little else is known about this person's life: not much about this person's life and work has been published. Your main objective is to formulate interesting questions to obtain information that could enrich your article. You want this article to be published in a famous magazine.

Profile 2: Journalist B

You are a journalist who is going to interview an important engineer next week. This engineer is a very famous woman but very inaccessible. Due to her innovative and profitable discoveries, she is now in the media but little else is known about her: not much about her life and work has been published. Your main aim is to formulate interesting questions to obtain information that could enrich your article. You want this article to be published in a famous magazine.

Profile 3: Famous male engineer

You are a famous male engineer unknown to the public. Your breakthroughs are of vital importance these days. You are going to be interviewed by a group of journalists. Your answers will be useful to shed light on your personal and professional life.

Profile 4: Famous female engineer

You are this woman engineer who is going to be interviewed by a group of journalists. You are a very famous engineer unknown to the public whose famous research outcomes are very important to the world now. In this interview with journalists, your answers will be useful to shed light on your personal and professional life.

4.1.3 Objective

To enhance female students to study engineering and to break the stereotype that engineering is a man's world.

4.1.4 Facilitator's directions

Materials needed: Internet access, the texts about engineering seen in class.

Activity type: simulation.

Time: Background study 10 minutes; action 20/30 minutes.

Number of participants: 8 students per group.

4.1.5 Briefing

Divide the class into 2 groups of 15 people approximately. One group has the role of Journalist A and the other Journalist B. After finishing the questions, in a second step, each class chooses a famous male engineer among the boys and a famous female engineer among the girls. The other students are, then, journalists.

Allow group members 2 minutes to read over their profile sheets. The teacher/facilitator clarifies questions before the activity starts.

4.1.6 During the Simulation

First, each group spends up to 10 minutes to formulate 10 questions that will be asked to the guest, 5 questions about the guest's private life should also be included. Then, in a second step one male student is the famous engineer and the others are journalists. Later, a female student has the role of a famous engineer while her colleagues are reporters.

4.1.7 Debriefing

When all the groups have prepared the questions, have asked them to the famous male engineer and female engineer the class discusses about:

- The questions developed, that is, if they are gender biased or there is no difference;
- The role of the famous male engineer;
- The role of the famous female engineer;
- The simulation carried out. The facilitator may ask some debriefing questions such as:
    - When you were in your role, did you really feel like you were a famous engineer or a journalist? And about your classmates' role, what is your opinion about their performance?
    - Do you think these strategies serve to break gender stereotypes?
    - Do you now consider that engineering is a man's world?
    - What else could you be able to do to raise interest in the engineering field? (for students of engineering)
    - Are you now interested in studying engineering? (for high school participants).
    - Do you think these simulations create a more attractive environment for speaking activities?

4.1.8 Summary of the simulation

- Divide each class into groups of approximately 8 participants each.
- Allow participants several minutes to read over the information provided and their profile sheet.

- Clarify any questions about the activity.
- Let each group decide their questions.
- Allow participants to develop their roles.
- Debrief participants.

4.2 Activity 2

The Massachusetts Institute of Technology (M.I.T.) Students' Activity Office organises what the institution calls *Charm School* (http://studentlife.mit.edu/sao/charm). These activities are mini classes on a different number of issues that an engineer should come up against after graduation like communicating successfully in a multicultural workplace, dress codes for work, dinning etiquette and table conversation, among others. In this line, this activity consists in developing a mini course that students choose from a list. The professional character of the activity forces it to be developed only in the university class.

Background

In the ESP course, students have seen the topic *Engineering* in class. Some issues have arisen from the reading activity such as the idea that engineers are mostly male, boring and dirty (*Language Leader*, 2008: 90).

In class, the teacher reviews the webpage of the MIT Charm School and the video that appeared in the CBS Morning Show about these mini courses. The class is divided into two groups.

Participants are provided with a list of courses and a profile sheet. Each group chooses a course.

Situation

A student is the teacher of the mini course, the other participants of the group attend the course.

Objective

To address the negative stereotypes that came up in the unit and promote discussion.

Profiles

Teacher, course attendant.

Time

Background study: 2 hours; action 20/30 minutes.

Level

B1 or lower intermediate.

4.1.2 Profiles

Profile 1: teacher

You are a teacher giving one of the courses, gather the necessary information to give the course.

Profile 2: Attendant

You are a university student in the field of technology and computing who is attending a mini course on social skills important for your future workplace.

4.1.3 Objective

To raise discussion on the role of women in the engineering world and on the stereotypes assigned to engineers in Western societies.

4.1.4 Facilitator's directions

Materials needed: Internet access to the Charm Scool, the texts about engineering seen in class.

Activity type: role play.

Time: Background study 2 hours; action 20/30 minutes.

Number of participants: 16 students per group.

4.1.5 Briefing

Divide the class into 2 groups of 15 people approximately. In each group one person has the role of teacher while the others are attendants. The "mock" course takes place.

Allow group members enough time to prepare their roles. The teacher/facilitator clarifies questions before the activity starts.

4.1.6 During the activity

First, in each group the teacher gives indications on the topic elected. Students play the role of attendants and follow the indications of the teacher

4.1.7 Debriefing

When the mini classes finish, students comment upon the following:

- The topic of the mini course developed, that is, if it is successful professionally or not;
- The role of the teacher;
- The activity carried out. The facilitator may ask some debriefing questions such as:
    - When you were in your role, did you really feel like you were a teacher or an attendant? And about your classmates' role, what is your opinion about their performance?
    - Do you think these strategies serve to break gender stereotypes?
    - Do you now consider that engineering is a man's world?
    - Do you think computer scientists are geeks or nerds?
    - What else could you be able to do to break the stereotypes appointed by your coursebook?
    - Do you think these small simulations encourage more meaningful speaking activities?

4.1.8 Summary of the activity

- Divide each class into groups of approximately 15 participants each.
- Allow participants enough time to find information about the course developed.
- Clarify any questions about the activity.
- Allow participants to develop their roles.

- Debrief participants.

5. Results and implications

As for Activity 1, the questions developed by both classrooms showed no difference and no gender bias. For instance, we had questions of the type "How do you combine family and work?" in a group with no information about the gender of the person, or "How has that project influenced your personal life?" The only bias observed was when one university student asked if they could ask about *his* family, assuming that the famous engineer was a man. Students were successful in speaking in English for a purpose: organizing questions, making them, and playing roles.

A Likert scale questionnaire administered after the activity showed that high school students were more motivated and liked the activity more than university students: 80% strongly agreed on its interest while 58% of the university students enjoyed the activity. This may be due to the fact that traditional learning paradigms are deeply rooted in the university (Author, forthcoming); some tertiary students were reluctant to the introduction of role play or simulation activities while this is common practice in lower learning levels. On the other hand, university students valued very positively (78%) group work, as they see that their integration in group works is a fundamental requirement for their later employability; whereas, only 30% of high school participants strongly agreed on group work benefits.

Regarding Activity 2, students worked very hard to find information about the content of the chosen mini course. In their opinions, it was a real challenge to prepare the task, especially those students that played the role of the teacher. This may be the reason why university students enjoyed the second activity more, 89%. Moreover, the high consideration of this activity may also be due to the fact that it is a regular activity carried out in one of the best technological universities of the world, which may have increased Spanish students' interest and degree of satisfaction.

Generally, the most important outcome of these activities is that it has served not only to improve fluency in English but also to motivate students, a key issue in some studies on gaming and simulation (e. g., Squire, 2003). It has been a motivation factor in the topic and has acted as a starting point to discuss the role of women in engineering and how to break the stereotype that engineering is a man's world. Consequently, discussion on gender stereotypes gave rise to a debate about the analysis of stereotypes in science and technology that appear in mass media.

Specifically in the university, a follow up speaking activity was, then, to observe feminine and masculine roles in some of the students' favourite television series: *The IT Crowd*, a British comedy, and *The Big Bang Theory*, an American situation comedy. These two programmes are frequently used in class as the basis of a listening exercise. In general, these comedies show engineers as anti-social, and, although a parody, they serve to reinforce commonly held beliefs about professionals in the field (Clayton, von Hellens & Nielsen, 2009). Engineers, especially computer engineers, are shown as geeks or nerds, "they have a negative stereotype in spite of the perceived value of computers for businesses and individuals in current society" (Kendall, 1999: 280). As far as women's role is concerned, both comedies start with the incorporation of a female character into a man's world and its implications. In *The IT Crowd*, the female character is *Jen*, the newly appointed boss of the IT Department, a woman in a powerful position who does not know a word of computing. On the other hand, in *The Big Bang Theory*, the sitcom begins when a new neighbour moves to the building; unlike her masculine neighbours, *Penny*, a waitress, has not finished primary

education but she is the only sensible character in this geeky neighbourhood. Later on, more female characters called *nerdettes* o *geek chics*, the feminine version of nerds, are incorporated to the comedy (López Rodriguez, 2011).

Gender stereotypes may lower girls' aspirations for science and engineering careers, they may affect girls' participation in engineering education and work, discouraging female students and making the field particularly unattractive to them, as Hill, Corbett & St Rose (2010) commented. The debate about these comedies, gender roles and stereotypes has served to interest students on the topic even more; it has been useful to make students much more aware of the influence of stereotypes in present society while learning English. As Barak and Asad (2012) pointed out, learning is fostered with students' real life situations, experiences and interests.

On balance, as Scarcella and Crookall (1990) suggest, the fact that students have been actively involved in the tasks, has facilitated second language acquisition. Moreover, this project has addressed some of the non-language-specific competences that the CEFR promotes in language learning: interpersonal relations in the engineering world in Western societies. Using the specific context of science, technology and engineering, the educational benefits of games in the language class have been analysed. Besides the practice of the English language, we consider that these activities may also be effective to close the gender gap in technology education. And yet, more activities are still needed to break negative stereotypes that could provide misleading ideas about the engineering world, discouraging girls from participating in a so called "traditional man's world".

We would like to conclude that the simulation and the activities presented in this paper can be just a small step in this fight against gender bias in technical degrees but in our opinion, every single action can serve to increase the presence of women in these studies. As Hill, Corbett & St Rose observed: "… at colleges and universities, little changes can make a big difference" (2010: XV).

Further studies may deal with fluency versus the level of linguistic accuracy in simulations for language learning, an issue arisen by Richards (2008). Other initiatives for fighting gender imbalance in technology may incorporate the use of other strategies such as role inversion and riddles.

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