# Female Higher Education teachers use Digital Technologies more and better than they think

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## Abstract

The unequal status of female teachers in higher education is a reality. However, are digital technologies another reason for their exclusion? The main aim of this study was to analyze the integration of digital technologies in teaching from a gender perspective. The research was a multiple case study applying the quantitative method. The sample comprised 527 teachers from four Spanish universities. The instrument utilized was a self-administered survey. The results confirm both types of segregation and the fact that female teachers see themselves as less digitally competent than their male counterparts; ironically, the findings also show that the former use information and communication technologies in teaching more than the latter. In conclusion, we highlight the need to study more deeply the intersection between digital breach and gender in higher education, and to take measures during the early stages of education to overcome female teachers' tendency of underestimating their digital competence.

## Keywords

higher education; education policy; teachers; digital technology; intersectionality

## I. Introduction

Despite the gender or "gender mainstreaming" policies (Pastor & Acosta, 2016; Verge & Cabruja, 2017) developed in many countries in the 21st century, the status of female lecturers in universities continues to be unequal compared with their male counterparts—this is called vertical segregation. For this reason, the influence of the equality policies endorsed by the studies of Frances (2017) in the United States; Henkel (2017) and Meschitti and Lawton-Smith (2017) in the United Kingdom; Morley et al. (2017) in Australia; and Lillie (2017) and Pastor and Acosta (2016) in Europe is insufficient.

The latest She Figures report published by the European Commission (2019) on the situation of women in academia shows that, since 2003, though there has been progress from the gender perspective, it has been slower than expected with still a long way to go. The report confirms that there persists a decrease in the number of women vis-à-vis academic career progression—40% of those hired in the lowest academic categories are women, and only 24% reach the higher positions (lecturer, senior lecturer, or professor). In almost all European Union (EU) countries, the number of women in these higher positions has increased since 2013—countries such as Portugal and France have improved women's status by one and a half to two points; the EU average reflects 22.1% of female lecturers in the highest academic categories in 2013, increasing to 23.7% in 2016. However, this is observed in all EU countries barring Hungary and Spain, where the percentage is declining. In 2013, 21.8% of the higher education faculty was female professors, senior lecturers, or lecturers, dropping to 21.3% in 2016. In other words, the percentage decreased despite gender policies, which indicates that these have not served to increase the presence of women in consolidated positions within academia.

This data matches the figures of the scientific report (Puy, 2017) prepared by the Women and Science Unit of the Ministry of Science, Innovation and Universities of Spain. Basically, while at the beginning of the academic career, the percentage of both women and men is on an even level, as the career progresses towards stability and more recognized positions, the number of women decreases—of the non-stable staff, 48% are women, of which only 42% manage to reach a stable position and 21% the position of professor. Based on this, the most pronounced gap is found in permanent positions, thus confirming the validity of vertical segregation.

The reasons behind vertical segregation have been studied extensively since the 1990s (Morley, 1995), with the main one continuing to be the difficulty in reconciling the tasks traditionally associated with the female gender—related to caring for people—and those related to scientific work, characterized by its high demand for dedicated time and the high complexity involved in promotions (Forster, 2000; Probert, 2005). Previous studies have also revealed another set of barriers that persist even today, helping to perpetuate inequality, from which the following are highlighted:

- Stereotypes about women, causing their role to be associated with functions far from positions of power
- The small number of women who hold positions of power and can serve as female role models (García de Leon, 2014)
- The female tendency to conform, over-adapt to the norm (Arranz, 2006)
- The meritocratic promotion system that is considered objective, though it fails to be (García-Dauder & Pérez-Sedeño, 2017; Ion & Duran-Bellonch, 2012; Van der Brink & Stobe, 2009)
- The tendency of female teachers and researchers to think they are less competent and less competitive than their male counterparts (Duarte, 2012; Pritchard, 2010)

- Eminently male informal power networks (Fritsch, 2015; García de León, 2014; Guil, 2016)
- The widespread misconception about gender equality being already achieved in academia (Torrado & González, 2017)

On the other hand, horizontal segregation refers to the few women who enroll in higher studies related to science, technology, engineering and mathematics (STEM). The study by Reinking and Martin (2018) analyzed the reasons for the presumed disinterest of women in STEM professions, concluding that the socialization process based on stereotypes about women's role being far from scientific and technological areas, as well as the stereotypical image of the scientific profession seem to be behind women's low participation in the STEM field. The results of the research by Schorr (2019) are especially alarming—the author stated that girls continue to be less interested than boys in scientific and technological areas due to the effect of socialization. The study by Lynn and Wittung-Stafshede (2020) confirms the persistence of double segregation—horizontal and vertical—mainly in the fields of natural sciences and engineering.

Based on the Eurostat results, Martínez-Cantos and Castaño (2017) noted that in both Europe and Spain, women have fewer digital skills than men. The authors, in their theoretical review, concluded that women use the internet less than men, share less content online, seek less information on the web, and contribute less to collaborative platforms. In terms of online activities, men download more software than women, buy and sell more, bank more, and read more newspapers online, while women search for health and education topics more frequently and use social networks more.

Not all social groups have had or have the same ease of access to digital technologies though, a phenomenon that has been called the first digital divide. Van Dijk (2005) concluded that gender is a determining factor generating access inequalities. He also investigated how teachers utilize digital technologies, given that significant asymmetries have been detected in terms of experiences and results derived from the use of information and communication technologies (ICTs), known as the second digital divide. Specifically, two essential dimensions are studied: digital skills and their usage patterns.

Whether the digital gender gap is at the base of horizontal segregation is a matter of consensus between researchers—that is, in STEM professions, there are fewer women due to the digital divide (Reinking & Martin, 2018). Tiainen and Berki (2018) investigated the academic career of female university lecturers dedicated to digital technologies in Finland and found that they continue to be underrepresented, despite the equality plans carried out by universities in the country; this is considered one of the most sensitive gender issues. The authors also criticized the difficulties in obtaining information for their study due to the lack of statistical data based on gender.

However, there is no consensus in the literature on the digital gender gap related to access and use of digital technologies amongst university lecturers; some studies find differences due to gender, while others do not. After studying the technological skills of lecturers, Ben Youssef et al. (2013) stated that female lecturers are more innovative in the use of digital technologies than their male colleagues. Guerra et al. (2010) investigated the use of digital technologies as a teaching resource amongst female lecturers and found that they tend to use the internet and telematic systems more than their male counterparts. Along the same lines, Lane and Lyle III (2011) found significant differences between male and female lecturers vis-à-vis the use of ICTs, with the former being the ones who use it more if the variable "experience in use" is not controlled; when this variable was controlled, the differences were no longer significant. In Chile, Del Prete and Cabero (2020) found no significant differences between male and female lecturers in the didactic use of the Moodle platform in higher education.

In Spain, Fernández et al. (2018) confirmed that, in most of the previous studies, gender is a differential variable, with male lecturers being more technically competent than their female counterparts; however, the latter are the ones who make greater effort to integrate digital technologies into teaching. The results of their research are consistent with the previous statements. In addition, they concluded that regardless of the educational level in which teaching is provided, despite the discourse being mostly positive towards ICTs, teachers in general use them sparingly in the classroom.

The results obtained by Marcelo, et al. (2015) on the uses of digital technologies by university lecturers in Spain are revealing: despite the methodological revamp that has been promoted in recent years to be in sync with European Higher Education, there has been little integration of digital technologies in the classroom, with only 16.7% of lecturers showing an advanced level of use of ICTs. These results do not show a digital gender gap since 50.3% of advanced level lecturers are men and 49.7% women. Even amongst the lecturers who show infrequent use of digital technologies in the classroom, the numbers are around 50% vis-à-vis gender. Likewise, Sánchez Prieto et al. (2020) also found no significant differences between the genders with respect to application of digital skills in the classroom in professional and dual education.

The studies conducted in the university classroom are limited in the analysis of the specific use of any tool. Early studies on the application of some social networks, such as Twitter, indicate that students use them sporadically and superficially, without a solid connection with the academic aspect (Gómez et al., 2012). However, more recent studies conclude that the tool is more useful at the educational level—the research by Gewerc et al. (2014) rejects the idea of the superficiality of Twitter use, as well as of procrastination. Their results indicate that despite the complete freedom to students to write on social networks, these provide a “high level of relevance of the content produced” (2014, p. 62). Likewise, Santoveña-Casal and Bernal-Bravo (2019) highlighted that the use of this social network is a good methodological option for student motivation.

Regarding the barriers to the use of digital technologies in teaching, specifically in secondary education, by the beginning of the 21st century, Jenson and Brushwood (2003) had already determined that male teachers were recognized as technology experts in the educational context. More than a decade later, the studies by Martínez-Cantos and Castaño (2017) confirmed the same trend through the acknowledgement of digital competences in male teachers alone, while also showing that female teachers tend to underestimate their level of knowledge and skills in the use of ICTs. In the same line, Mercado and Rodea (2019) affirmed that the collective imagination continues to relate men, and not women, to technology. On the other hand, Islahi (2019) found no significant differences in the attitudes of teachers towards the integration of digital technologies according to their gender.

In higher education, Lane and Lyle III (2011) stated that women perceive more barriers than men, especially in relation to the lack of time and training, lack and/or poor quality of infrastructure, and technical problems. However, in her study, Mercader (2019) found no differences between genders except for the fear that technology is a threat to the institution, a barrier most commonly found amongst male teachers than female ones. Along these lines, Al-Senaidi et al. (2009) concluded that male teachers perceive more barriers than their female counterparts vis-à-vis the integration of digital technologies into teaching. Likewise, Al Gamdi and Samarji (2016) found that female lecturers perceive fewer barriers in the implementation of e-learning in higher education.

Numerous studies show that digital competence is essential for university educators to ensure that teaching goes from teacher-centered practices to student-centered practices (Lin, Hoffman & Borengasser, 2013; Salcines, González & Briones, 2017); but there are few cases of studies that specifically address the digital female gap and its consequences on the learning process of students. The present study focuses on digital technologies in university teaching of female

lecturers. It specifically looks into their perceptions about their own competence, and the barriers they encounter in the technologies' integration and in their use of these technologies in higher education.

## II. Material and Methods

The revision of the literature highlighted mainly the differences between male and female teachers on the of digital technologies, but more empirical and recent studies were needed, since the technology field is in constant evolution and gender policies are changing in every context. Therefore, the aim of this study was to analyze the gender differences in teaching vis-à-vis the integration of digital technologies. To that end, two objectives were pursued: 1) comparison of the two genders' use of digital technologies in teaching and 2) analysis of female lecturers' perceptions of their level of technological mastery and their perceived barriers to the integration of digital technologies in university classrooms.

### a. Methodology and Instruments

Quantitative methodology was used for the development of this research through the multiple case study method. Four universities were selected. Two of them are public (A and B) and two of them private (C and D), moreover, two are located in urban areas (A and C) and two in a more rural environment (B and D).

For data collection, a three-part questionnaire was prepared—section A comprised eight items and corresponded to the sociodemographic data and lecturer profile; in section B, seven items referring to the integration and use of technologies for teaching purposes were proposed, with a scale of frequency of use and the perception of their own technological domain; and section C comprised 33 items in a Likert-type scale on the barriers lecturers face in the integration of digital teaching technologies in higher education.

The instrument was validated by 12 lecturers with expertise in the field of digital technologies. After data collection, Cronbach's alpha test was performed, and positive values were obtained, thus reinforcing the instrument's reliability (.877 for section B and .874 for section C). The instrument was applied online by the lecturers themselves through the LimeSurvey platform, which was available during 3 months for them to answer it. With respect to ethical considerations, all participants received detailed information of the study conditions: purpose, researchers involved, confidentiality of data, anonymity, voluntary participation, and their right to withdraw at any time.

### b. Sample

The study sample comprised teaching staff from the four participating universities (N = 527): Universitat Autònoma de Barcelona (35.3%), Universitat de Lleida (30.6%), Universitat de Vic-UCC (18%), and Universitat Internacional de Catalunya (16.1%); the sample was selected in a stratified manner to maintain representativeness by universities and disciplines.

Amongst the participants, 51.4% identified as male and 48.6% as female, even though there was an "other" option, no one selected it. The sample collected represents the different academic fields maintaining the proportion of the teachers that each university participating have (Figure 1). Their ages ranged between 23 and 70 years (M = 46.15; DT = 9.92) and work experience between one and 45 years (M = 14.47; DT = 10.29). With respect to their professional category, the majority are part-time teachers (34.2%), followed by seniors (23%) and senior associates (20.3%); the

remaining are junior associates (7.4%), collaborators (4.6%), professors (4.4%), predoctoral fellows (3.2%), and postdoctoral fellows (2.5%).

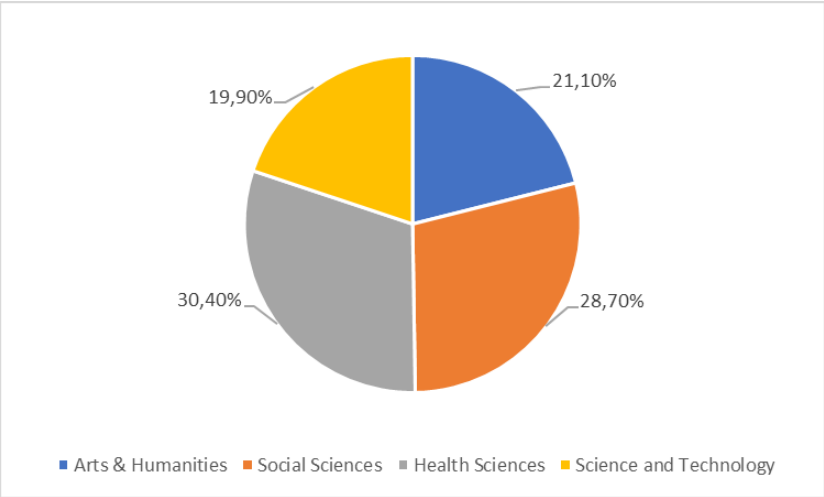


Figure 1. Distribution of the sample by academic fields.

### c. Data analysis

The questionnaire results were analyzed with the SPSS statistical package (v.22), and univariate and bivariate tests were conducted for the statistical description and analysis of differences, using the chi-square and non-parametric Mann-Whitney U tests, after checking the homoscedasticity of the variances.

## III. Results

In line with the study objectives, the results are presented in two sections: 1) the situation of women at university and vis-à-vis the integration of digital teaching technologies and 2) the descriptive statistics differentiated by gender regarding the perception of the level of technological mastery and barriers to the integration of university teaching technologies.

### a. Women at University and the use of Digital Technology

First, the variables referring to the discipline and professional category were analyzed as part of the general mapping of the situation of women at university. The results show differences between the fields of health sciences and science and technology—in the former, 60.6% lecturers are female and 39.4% are male, while in the latter, these numbers are 32.4% and 67.6% respectively (chi-square = 21.941, df = 3, $p < .000$). With respect to the professional category, Figure 2 shows the differences in the distribution of the male and female participants in each position—the most prestigious categories (professor and senior lecturer) are mainly occupied by men, while the most unstable and non-permanent ones (predoctoral fellow and collaborator) are clearly feminized.

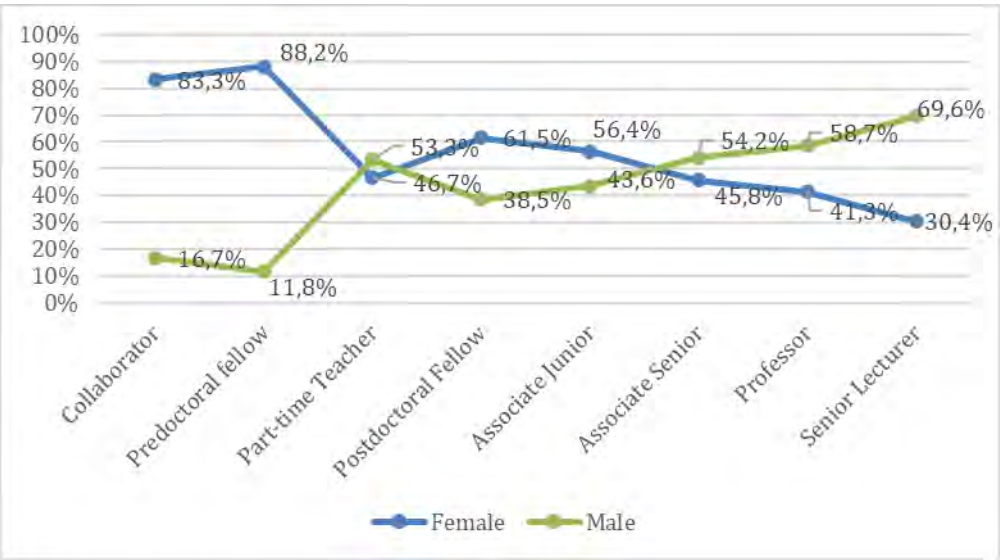


Figure 2. Female and men distribution according to their professional category.

When analyzing the digital technology-related variables, it was observed that both the male and female participants spent nearly equal number of hours in the personal use of digital technologies, with a slightly higher average in the case of the women—3.63h per day (DT = 4.24)—compared with the men's 3.57h per day (DT = 6.34). In any case, these differences are not significant.

In terms of training, both genders have taken courses in digital technologies for university teaching (60.9% women and 57.6% men), research (38.3% women and 30.6% men), and management (13.7% women and 19.9% men)—in other words, fewer women have taken courses in management, while fewer men have taken courses in teaching and research; the chi-square test confirmed that these differences are not significant.

With respect to the use of technologies to spread and share knowledge, it was found that more female participants use wikis (50.5%), forums (52.4%), and social networks (51.7%), while their male counterparts are more inclined towards blogs (53.7%) and in a significant manner (chi-square = 14.186, gl = 1, p < .000), and the web (59.3%). However, when the variable referred to the implementation of different tools for teaching purposes, the female participants stood out in most of them (Table 1).

| Tool | Women | Men |
|---|---|---|
| Visual Presentations | 98.00% | 95.90% |
| Video Platforms | 83.20% | 84.10% |
| Interactive Software | 36.70% | 39.10% |
| Simulations and/or animations | 41.40% | 44.60% |
| Twitter | 10.20% | 8.90% |
| Facebook | 11.30% | 9.60% |
| Other social networks | 11.30% | 11.80% |
| Collaborative networking | 64.50% | 56.10% |
| Blogs | 34% | 29.90% |
| Wikis | 31.30% | 26.60% |

| | | |
|---|---|---|
| Forums | 50% | 41% |
| Virtual Platforms | 90.20% | 86.30% |
| Cloud storage | 78.10% | 66.40% |
| Online Forms | 47.30% | 39.90% |
| Personal Learning Environment | 16.00% | 14.80% |
| Videoconferences | 35.90% | 34.70% |
| Academic search engines | 60.90% | 58.70% |

Table 1. Use of digital tools in university teaching sorted by gender.

The results also show that almost all of the male and female participants use visual presentations (98% women and 95.9% men), virtual platforms (90.2% women and 86.3% men), and video platforms (83.2% women and 84.1% men) for teaching purposes; the least used tools are social networks: Twitter (10.2% women and 8.9% men), Facebook (11.3% women and 9.6% men), and other networks (11.3% women and 11.8% men). Significant differences by gender were identified in the collaborative network work (chi-square = 3.843, gl = 1, $p < .050$), in the use of forums (chi-square = 4.341, gl = 1, $p < .037$), and in the use of cloud storage tools (chi-square = 8.966, gl = 1, $p < .003$). In all cases, it was found that more female participants use the mentioned tools; in the cases where the male participants make more use of one tool (video platforms, interactive software, simulations and/or animations, and other social networks), the differences were not found to be significant.

### b. Women's perceptions of dominance and barriers to the integration of Digital Technologies

The results referring to the perception of technological mastery show the trend at the average level —that is, 51.2% of the female participants and 49.8% of the male ones. However, in the distribution by domain, differences due to gender were observed in the rest of the levels. As shown in Figure 3, more female participants are at the initial level (60%), while more male ones are at the advanced (55.9%) and competent levels (52.5%).

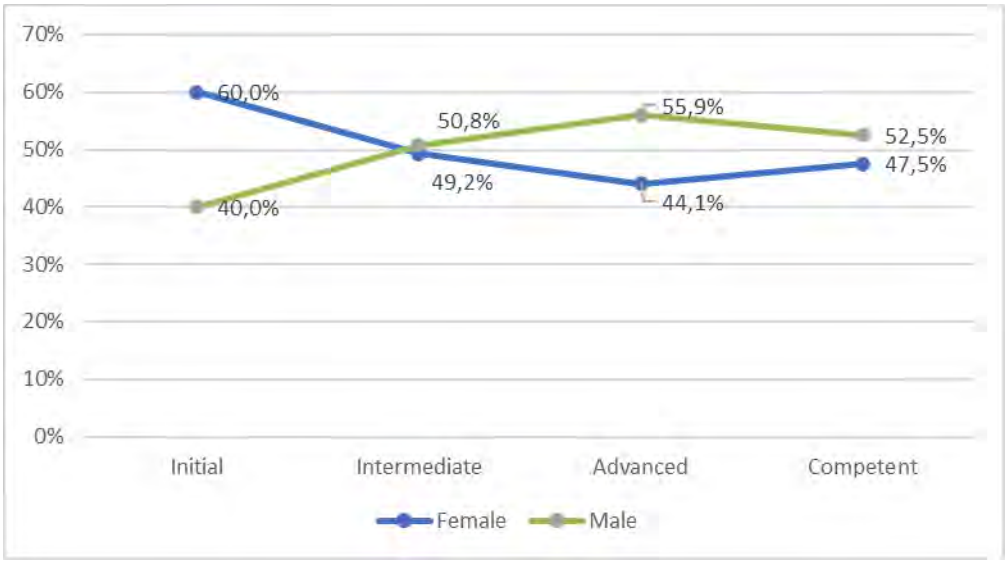


Figure 3. Female and male distribution according to their perceived technological mastery.

The teachers' most perceived obstacles in the use of digital technologies were revealed to be personal, professional, and institutional barriers. Table 2 shows the data distributed by the level of intensity of the barrier. Of the 33 barriers, seven in higher education were identified by at least two-thirds of the teachers, as indicated in Table 2, given that they "agree" or "strongly agree" that it is a reason for the lack of integration of digital technologies.

| Barrier | Level of intensity | | | |
|---|---|---|---|---|
| | Strongly Disagree | Disagree | Agree | Strongly Agree |
| Lack of assessment over the use of DT | 3.90% | 14.80% | 32% | 49.30% |
| Lack of institutional planning | 7.40% | 24.20% | 41.10% | 27.30% |
| Technophobia | 4.70% | 13.70% | 47.10% | 34.50% |
| Generational gap | 6.20% | 16.80% | 45.70% | 31.30% |
| Lack of training | 8.20% | 24.20% | 50% | 17.60% |
| Lack of work incentives | 2% | 8.20% | 40.60% | 49.20% |
| Lack of time | 2.70% | 19.50% | 43% | 34.80% |

Table 2. Women's most common barriers to the use of digital technologies.

The barrier with the highest percentage is Lack of Work Incentives, identified by 89.8% of the female participants. Similarly, the systematic and irrational rejection of the use of technologies (Technophobia) and lack of teaching supervision in the use of digital technologies (Lack of assessment over the use of DT) are the other barriers identified by 81.6% and 81.3% of the female participants, respectively; meanwhile, 77.8% of the female participants perceived Lack of Time to be a barrier that makes it difficult to integrate teaching technologies, and 77% identified that the problem lies in lecturers' generation gap in the classroom (Generational Gap). Finally, 68.4% of the female participants acknowledged the lack of institutional planning related to the integration of digital technologies, and 67.6% considered Lack of Training as a barrier that prevents their normal integration.

A comparison with the male participants' perception about the existence of these barriers revealed significant differences in two of them, with the female participants showing higher values in their identification. In terms of lack of teaching supervision in the use of digital technologies (Lack of Control over the Use of ICTs), the Mann-Whitney U test indicated that the barrier is higher amongst the female participants than amongst the male ones ($U = 30535$, $p = .010$). The same was observed vis-à-vis the identification of Lack of Work Incentives as a barrier to the integration of ICTs, with the female participants showing significantly higher identification values than their male counterparts ($U = 30924.5$, $p = .018$).

## IV. Discussion and Conclusions

The aim of this study was to analyze the incidence of gender in the use of digital teaching technologies in higher education, as well as the perceptions women have about their digital competence and the barriers that hinder the full implementation of ICTs. The results suggest that there are more women than men using technology for teaching purposes, though the difference is not significant. Despite this, there is a gender gap in the self-perception of technological mastery,

given that the distribution by level shows significant differences—that is, more men identify with the highest level of such mastery, and more women identify with the lowest level of it.

With respect to the professional positions of women at university, the results show that horizontal segregation is maintained, since the vast majority of lecturers in the field of science and technology are male, while disciplines such as health sciences are feminized. In this sense, the findings of this study coincide with the review by Reinking and Martin (2018), which evidences this trend. Likewise, women continue to be more represented the lower the category and less represented the higher the category. For this reason, the resulting graph reproduces the so-called scissor effect, showing the perpetuation of vertical segregation (European Commission, 2019; Puy, 2017). It is also observed that women undergo more training than men in teaching and research, but not in management, which is consistent with vertical segregation, since they have poor access to positions of power.

The differences are more marked in the use of digital technologies in the classroom, since the type of such technologies employed by men and women is different. Women excel in the use of social tools, in which knowledge is shared and debates are generated and/or collaboratively built with other people, while men tend to use tools that do not require social interaction, such as interactive software and/or simulations and animations. Furthermore, when compared with men, women stand out in terms of the integration of most digital tools—that is, differences in the way they are implemented. This is consistent with Fernández et al. (2018) and Guerra et al. (2010) when considering that female lecturers use them more for teaching purposes. In this sense, the findings contrast with those of other studies such as the ones by Lane and Lyle III (2010), Marcelo et al. (2015), and Martínez-Cantos and Castaño (2017), in which the use of digital technologies for teaching purposes is more common amongst male lecturers; therefore, vis-à-vis the first objective of this study, it is concluded that women are better trained and integrate digital technologies more into their teaching.

In contrast, and vis-à-vis the second objective, women perceive themselves as less competent than men in terms of mastering technology. They thus tend to situate themselves in the lower levels of mastery, while men tend to place themselves at the highest level (Fernández et al., 2018; Mercader, 2019). This perception is inconsistent with the findings on the use of technologies previously analyzed. Women make more use of the teaching technologies than men but see themselves as less competent than them—that is, female lecturers underestimate their level of digital competence, which is consistent with the findings of Martínez-Cantos and Castaño (2017).

Women perceive that the existing barriers to the integration of technologies in higher education demand institutional intervention. It could be interpreted that women still believe they must follow the external indications coming from the institutional power organs, thus considering the integration of digital technologies to be conditional to the supervision of their teaching performance and incentives for the use of ICTs; consequently, women would continue to be more dependent than men.

In conclusion, the study shows differences between female lecturers' perceptions of their relationship with digital technologies and the reality of their use of those for teaching purposes; it also evidences the horizontal and vertical segregation that persists in higher education. Consideration of only gender and technology variables can be taken as a limitation of this study. The digital gender gap in higher education could be another source of inequality, affecting the same person or group such as race, social class, gender, sexuality, ethnicity, nation, ability, and age (Blithe, 2019; Savigny, 2019). Future lines of research could study the digital gender gap from an intersectional perspective (Collins, 2015), considering it as an intersection category along with those mentioned above.

The health crisis has evidenced that universities have witnessed non-attendance with technologies, and therefore, not addressing this issue could further widen the digital gender gap. In summary, perception does not coincide with reality, and thus, it is necessary for women to improve their self-

concept and self-image vis-à-vis digital technologies. To achieve this, it is necessary to empower women from their early years and throughout all educational levels, which necessarily involves institutional commitment and development of plans that value their already acquired competences, thus enabling better self-perception.

Specifically, recommendations for the university governance and the higher education teaching focus on increasing the visibility of the use of digital technology by female lecturers in university teaching. A suitable context for this could be the faculties of education, which through workshops, symposiums, or open forums can facilitate the dissemination of good and make other female lecturers aware of their own expertise. Congresses on digital technology and teaching could be another suitable scenario to disseminate the existence of the digital gender gap, the need to eliminate it and the cases in which it has been overcome.

## Acknowledgments

This work was supported by the University Teacher Training Program (FPU) of the Ministry of Education, Sports and Culture of Spain, under Grant FPU2014/260.

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