Gender equality and ICT in the context of formal education: A systematic review

Igualdad de género y TIC en contextos educativos formales:
Una revisión sistemática

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ABSTRACT

This article focuses on gender equality as one of the most relevant objectives of the educational system to alleviate gender violence and combat stereotypes. At the same time, ICTs have become a very important educational tool in a digital society like the one where we live. Around these two topics we conducted this research whose purpose is, from the scientific production of the last six years, to analyze the educational practices in formal contexts that deal with gender equality and ICTs (infant, primary, secondary and higher education). The research design is a systematic review, based on the PRISMA statement and the PICoS strategy, using the 2013-2019 search period. After a screening process of a total of 90 documents, 18 papers were found that cover both study topics (gender and ICTs). A content analysis supported by semantic networks was performed, using Atlas.ti v.8. Among the main results, we highlight that most of the good practices in the different educational levels are related to the use of web 2.0. and STEM competences. Finally, we recommend the design of proposals that work on gender through ICTs, with the "smart classroom" as an interesting suggestion that is part of the emerging pedagogies.

RESUMEN

Este artículo centra su interés en la igualdad de género, como uno de los objetivos más relevantes del sistema educativo para paliar la violencia de género y combatir los estereotipos. Paralelamente, las TIC se han convertido en una herramienta educativa muy importante en una sociedad digital como la que vivimos. En torno a estos dos tópicos llevamos a cabo esta investigación cuyo propósito es, a partir de la producción científica de los últimos seis años, analizar las prácticas educativas en contextos formales que trabajen la igualdad de género y las TIC (educación infantil, primaria, secundaria y superior). El diseño de investigación es una revisión sistemática, sustentada en la declaración PRISMA y la estrategia PICoS y usando el periodo de búsqueda 2013-2019. Tras el proceso de filtrado de un total de 90 documentos, se han encontrado 18 trabajos que contemplan ambos tópicos de estudio (género y TIC). Se ha realizado un análisis de contenido apoyado en redes semánticas, usando para ello Atlas.ti v.8. Entre los principales resultados, destacamos que la mayoría de buenas prácticas en los diferentes niveles educativos se relacionan con la utilización de la web 2.0. y con las competencias STEM. Por último, se recomienda el diseño de propuestas que trabajen el género a través de las TIC, siendo la «smart classroom» una sugerencia de interés que forma parte de las pedagogías emergentes.

KEYWORDS | PALABRAS CLAVE

Coeducation, feminism, gender equality, educational technology, childhood education, primary education, secondary education, higher education.
Coeducación, feminismo, igualdad de género, TIC, educación infantil, educación primaria, educación secundaria, educación superior.

1. Introduction

"All human beings are born free and equal in dignity and rights". This is the first article of the declaration of human rights. However, organizations such as the WHO have highlighted that gender violence is currently an imperative public health problem, regardless of the culture of origin (WHO World Health Organization, 2013). It is a social pandemic present in all countries (Torres, 2010). The term gender differentiates between biological and social components and also involves stereotypes such as passivity, dependence, and obedience, which aggravate inequality, subordinating the feminine to the masculine with negative consequences for women (Ferrer & Bosch, 2013; Sánchez-Casales, 2014; Egea, 2019). We consider it meaningless to use the term equality without referring to the earlier feminist movement. (Pino, 2017). Today's feminism must seek a socialization that benefits from total gender equality, far from its false image, which results from myths and stereotypes (Solís, 2007; García-Jiménez, Cala, & Wheat, 2016).

At present, a widespread means to raise awareness and denounce gender inequality is through cyberfeminism, a concept that links technology, the internet and social values, (Catalán, 2017; Sánchez & Fernández, 2017) and which has great potential in education (Mérida, 2019). One of the current worldwide cyberfeminist movements has been "#MeToo", as a means to report sexual abuse (Thissen, 2018). Traditionally there have been three models of classroom organization (Bonal, 1997): the segregated school (male and female students in separate spaces), the mixed school (both sexes in the same space) and the coeducational school (eliminating inequalities to offer both sexes the same opportunities). Despite social changes, many Spanish schools maintain the same spatial organization as they did five decades ago, which is why, as gender urban planning points out, a structure that favors egalitarian relations should be established (Saldaña, 2018). On the contrary, a culture that differentiates between gender-based expectations, skills and life plans continues to be perpetuated (Cordero, 2013). This begins in educational centers with sexual discrimination towards children and can cause difficulties in relationships in the classroom, and even be a cause of harassment (Ovejero, Yubero, Larrañaga, & Navarro, 2013), preventing academic success (Igbo, Onu & Obiyo, 2015). There has always been a tendency to divide students by gender for various activities, which further aggravates stereotyping (Rodríguez & Miraflores, 2018) and it has been demonstrated how inequality in schools is still present, although transformed into new, subtler forms (Ugalde et al., 2019).

Co-education remains a challenge for the school (López-Pascual, 2007; Subirats, 2016; Tomé, 2017; Egea, 2019; Ugalde et al. 2019). In practice, the so-called hidden curriculum (Pacheco-Salazar & López-Yáñez, 2019) continues, and textbooks are a good example of this (Women's Institute for equal opportunities, 2015). This situation puts not only the students in general at a disadvantage, but also specifically a group of students affected by homophobic and transphobic bullying, to the extent of even being a cause for suicide (Carrer, 2018). To combat this a model of coeducational school must be developed, supported by specific spatial arrangements, and a transformation of content and methodology; a change in mindset and a transversal approach to the problem (Bejarano et al., 2019; Gallardo & Gallardo, 2019). With these measures one can work to overcome sexism in a hierarchical education, favoring personal development, socialization and acceptance, and values and attitudes essential to stereotype-free growth (Pino, 2017). These achievements will inevitably be made through the improvement of teacher training, both in initial training (Bejarano et al., 2019) and continuing training (Gallardo & Gallardo, 2019). Carretero and Nolasco (2019) reveal that 75 % of future teachers could, albeit unwillingly, transmit sexist beliefs to their students. Amongst the various proposals for action, it is necessary to recognize the key role that technologies play in educational innovation and the improvement of the school curriculum (Escudero, 2014). The transition from a micro to a more global perspective in the field of technology has allowed us to replace an instrumental vision with a more methodological view (Cabero, 2003), in which technologies are ideal resources for communication, representation and expression of content, as well as the basis for shared construction of knowledge. In the context of formal education, recent work has expanded the ways in which we can learn with technologies, and how to promote change in classrooms in situations enriched by technologies (Prendes & Román, 2017; Serrano et al., 2016; Solano & Sánchez, 2016). This can serve as a starting point in promoting gender equality in the classroom. With the integration of technologies in the classroom, many educational institutions have been labeled "digital" (García-Aretio, 2019). However,

gender equality has not yet been greatly engaged by ICT's, as we demonstrate in our research. Some of our proposals are limited to the relative inequality of access for men and women to STEM subjects (Science, Technology, Engineering and Mathematics) Although there are several initiatives which work on gender through ICT's (Chamorro, 2010 ; Hirata, 2018; Rheingans et al., 2018), there is still a marked gender gap in both the professional and academic fields in reference to the use of technology (Calvo, 2019; Holth et al., 2016; Tiainem & Berki, 2019). The causes of this are various, including stereotyping of a lack of ability in females to work with technology. (Hill et al., 2010), the absence of female participants (Saéz & Clavero, 2016), and a lack of long-term teacher training (Pinedo et al., 2018). This is why it is necessary to highlight the usefulness of ICT in parallel terms: as a teaching content, employed so that STEMs do not contribute to gender inequalities, and as tools that both students and teachers can use, with female tudents even being empowered by the potential of ICT (González-García & Pérez-Sedeño, 2002). This role of ICT in the education of girls and women is seen as important by numerous international organizations (United Nations, 2015; UN WOMEN, 1995; UNESCO, 2006) (Boix, 2006; Gurumurthy, 2004) , and raises awareness of the need to combat the stereotype of technological competence as being a masculine quality (Gil-Juárez et al., 2012).

We consider that technologies are "allies in advancing equal opportunities, given the space-time flexibility they offer us and the opportunities for online collaboration" (García-Valcárcel & Arras, 2010: 10). Using this perspective, we base the objectives of this research on those developed within the project "Gender Equality Matters (GEM): Tackling Gender-Based Violence".

2. Methodology

This research is part of procedures carried out within the framework of the Gender Equality Matters (GEM) Project: Tackling Gender-Based Violence, funded by the Rights, Equality and Citizenship program of the European Union, which is to be developed in the 2018-2020 biennium.

Figure 1. Flowchart of the systematic review process
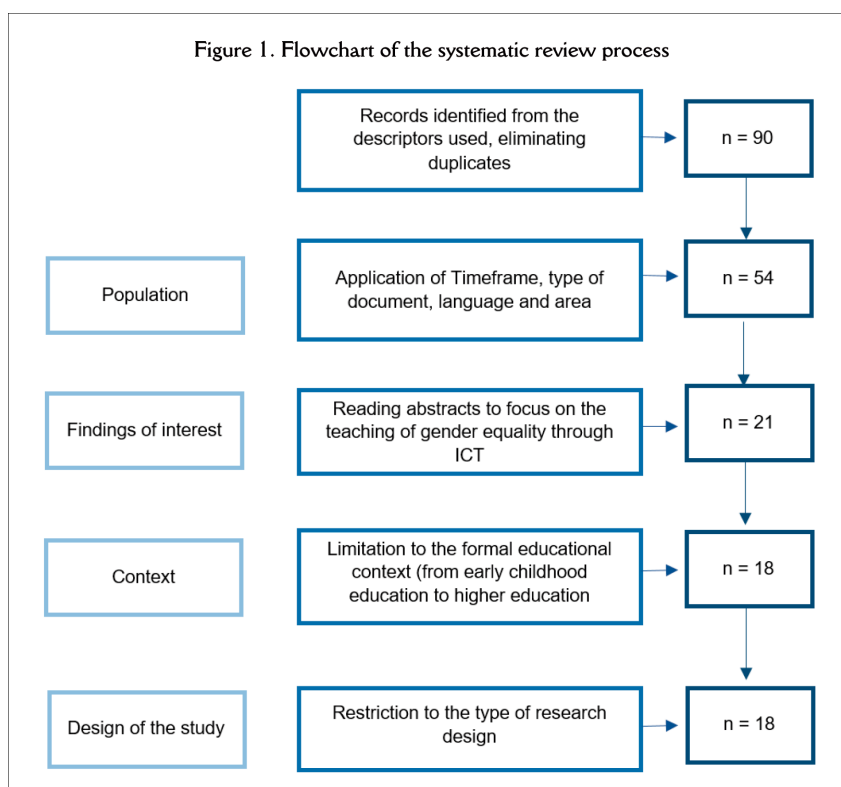
Our research question is: how is gender equality working through ICTs in formal educational contexts? In answering this question our objective is to analyze educational practices in formal contexts that work

on gender equality with the use of ICTs. In order to reference and analyze the most significant studies in this field, the systematic literature review (SLR) method has been used, following the indications set forth by Conn et al. (2003) regarding the need to generate a documentary corpus in order to facilitate the review. To accomplish this, a database (http://bit.ly/2o1tdjJ) of the selected sample was created, in which the process of re-reading, editing and selection of information is favoured.

2.1. Process

To carry out an optimal search for scientific productions and thus guarantee their validity, several criteria were taken into account, based on the proposal by Tacconelli (2010) and the PRISMA statement (Urrútia & Bonfill, 2010). The criteria were: inclusion and exclusion, relevance, study validity, data description, elimination of duplication, risk of bias, application of Boolean operators and bilingual descriptors. The axis from which the aforementioned criteria were applied is the PICoS strategy: population, events of interest, context and study design (Pertegal-Vega et al., 2019). Population is the first search criteria: the use in Spanish and English of the keywords gender equality, coeducation, education, ICT and technology; our timeframe was limited to the last 6 years (2013-2019); type of document (article, book chapter and conference communication); language (English and Spanish) and area (Social Sciences). All the selected documents come from the main international multidisciplinary databases (Web of Science and Scopus) and Dialnet. Limiting the review to the last six years seeks to reference the most current documents regarding the research problems addressed. In addition, it was found that, in years prior to 2013, studies referring to ICTs and gender equality education were relatively scarce.

The focus of this review is based on educating in gender equality through ICTs. That is, those proposals that directly address the issue or try to ensure the improvement of gender coexistence. The research context is formal education, from pre-school education (from 3 years) to university. The study design prioritizes quantitative and qualitative articles that analyze specific or longitudinal experiences. A flowchart of the review process supported by the PICoS strategy is shown in Figure 1. After a first search based on the use of the above descriptors, an initial sample of 90 documents was obtained. After a round of filtering, using the above criteria, the final sample was 18 documents. In the last phase of the study, the results were analyzed using two quantitative models that demonstrate both the type of sample analyzed and its distribution within the different educational levels investigated. The research problem is analyzed using a semantic network generated with Atlas.ti v.8. It encodes and categorizes the most significant units of information of the selected documents. Next, the 18 citations created are linked to the 4 free codes that correspond to each of the educational levels.

2.2. Analyzed sample

The different scientific publications analyzed in the final sample are presented chronologically in Table 1.

Table 1. Analyzed sample		
No.	**Reference**	**Country**
1	Barragán & Ruiz (2013)	Spain
2	García-Vázquez (2014)	Spain
3	Pär-Ola & Faheem (2015)	Bangladesh
4	Maldonado (2017)	Spain
5	Ferreira (2017)	Portugal
6	Permoser (2017)	Austria
7	Stucchi (2017)	Italy
8	Savinskaya (2017)	Russia
9	Barros, Vasconcelos, Araújo, Amaral, & Ramos (2018)	Portugal
10	Ferreira (2018)	Portugal
11	Hirata (2018)	Japan
12	Navarro-Pérez, Carbonell, & Oliver (2018)	Spain
13	Rheingans, D´Eramo, Diaz-Espinoza, & Ireland (2018)	USA
14	Sullivan & Umaschi (2018)	USA
15	Gkotzos (2018)	Greece
16	Martínez-Romera (2019)	Spain
17	Aguilar (2019)	Colombia
18	Mérida (2019)	Spain

3. Analysis and results

The bar chart in Figure 2 shows the sample as the type of document consulted within the different time frames. Despite the limited number of samples in international and national databases, it should be noted that there is a steady increase in the number of documents dealing with education for gender equality and nonviolence through ICT, with the exception of 2016. Taking into account the rise prior to 2019, an increase in jobs in ICT in the coming years is considered probable.

The teaching practices developed are most evident at the level of Secondary Education (works 1, 2, 4, 7, 10, 12 and 18 in Table 1), as shown in Figure 3.

Despite there being a gradual growth in relation to the educational stage, in higher education there is a decrease (27.78%) compared to secondary education (38.89%). This is due to the fact that university courses that educate on gender equality through technology are mostly those related to STEM competencies (works 9, 11 and 13 in Table 1), except in two cases of those selected (works 3 and 16).

Figure 2. Selected sample according to the type of document and its year of publication
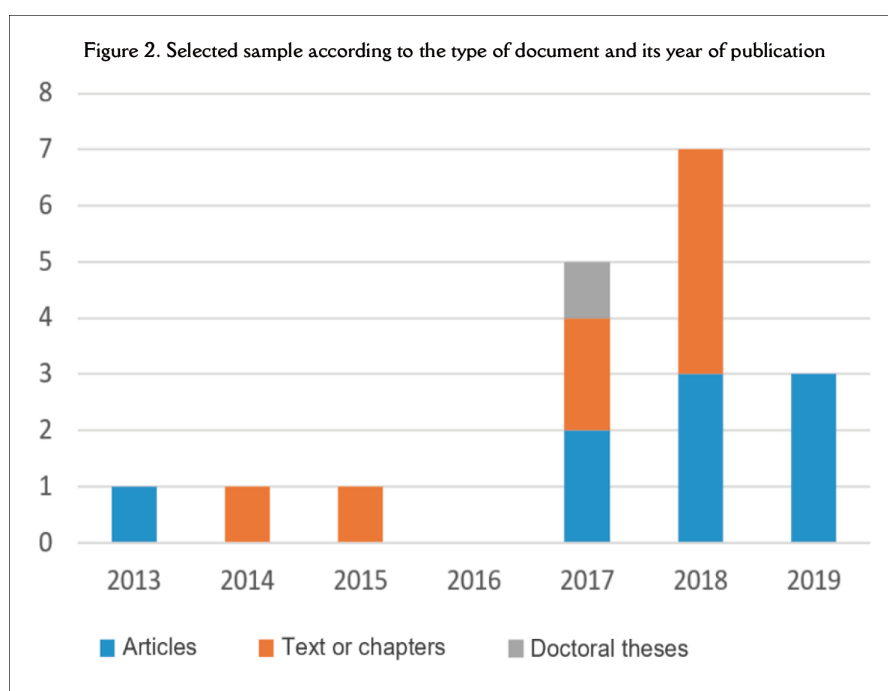
Proposals in Pre-school education are not completely non-existent, but are a minority (works 8 and 10). On the other hand, in Primary Education, gender equality and its treatment through technology (papers 6, 14, 15 and 17) is beginning to gain popularity.

We have developed a semantic network in order to visualize the results (Figure 4: http://bit.ly/2rxYo W7). Firstly, in Infant Education, gender equality has been examined in two different ways. On the one hand, through a project that regularly develops images, games and other digital resources (work No. 5), and on the other hand, through the STEM competencies which encourage and arouse female interest in these possibilities (work 8).

The inclusion of STEM competencies in Primary Education is promoted in order to encourage female interest in engineering and technology. We have found proposals about robotics (work 14), and in the development of cyberactivism, with digital discussion groups between schools (work 17) and, very relevant to this initiative, the development of web environments with which to play, learn and transform gender-based social reality (work 15). In Primary Education, a strategy known as peer tutoring has also been developed, addressing gender equality through a digital mentoring program among schoolchildren, which deconstructs gender stereotypes (work 6).

Figure 3. Didactic proposals analyzed according to their educational level
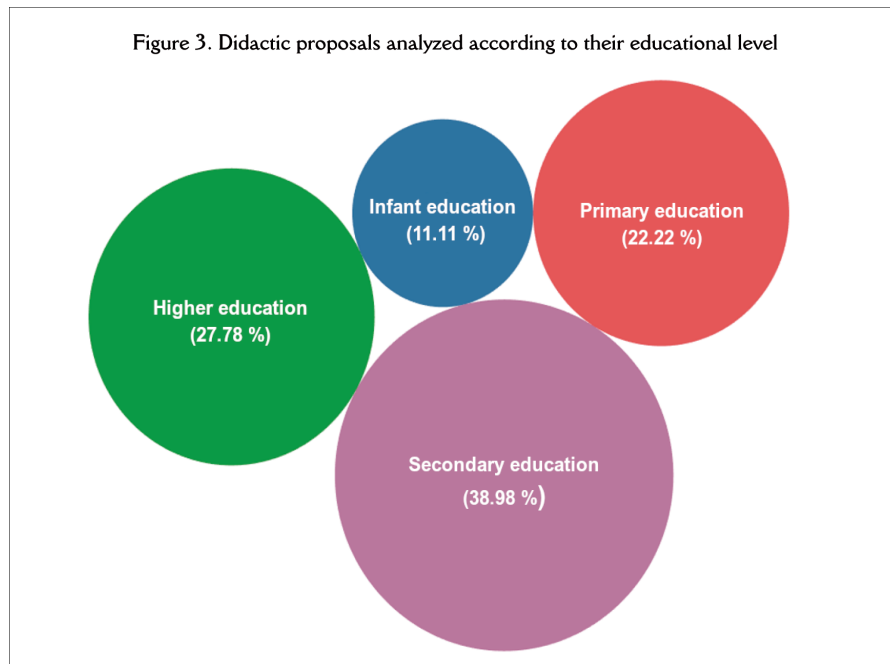
Similarly, to one of the proposals implemented in Primary Education, in Secondary schools, web 2.0 is also used to address cyber-activism, or in this case, cyberfeminism (work 18). Along the same lines, there are similar schemes, supported by blogs or digital social spaces, which work on subjects from a co-educational perspective, explicitly addressing feminism with activities and discussion forums (works 1, 5 and 7). In addition to schemes based on virtual environments, there are other projects based on different technological tools complemented by different strategies such as the flipped classroom or inverted class (works 2 and 4), or didactic proposals based on mobile learning, through a mobile phone application which tackles sexism (work 12).

Finally, in close relation to the proposals presented in Secondary Education, in Higher Education there are also proposals related to the use of web 2.0, through digital debates, which take place after viewing videos or talks (work 16). The use of specific programs which develop STEM competencies in university studies, such as engineering, is also examined in the selected samples (works 9 and 11). Finally, we must emphasize that two of the schemes are aimed specifically at females and develop certain technology-related skills. These specifically consist of integration in an undergraduate programme (work 3), and during an engineering course (work 13).

4. Conclusions

One of the most significant findings of our research is the lack of scientific literature on gender equality in education as examined through technologies. These are tools that would greatly contribute to alleviating social problems such as the gender gap - both in the professional and in the academic fields (Calvo, 2019).

The educational level with which more proposals are associated (7 codes), and that meet the established criteria, is Secondary Education (38.89%), which may be directly related to the fact that this is a stage in which gender violence in the classroom has been inherited from the previous educational levels, as indicated by Pastorino (2014) and González (2009).

Despite the "digital" label (García-Aretio, 2019) that educational institutions have been given, the resources used for dealing with gender issues remain mostly "analog", such as directed readings, role-playing games *or* traditional storytelling (López-Pascual, 2007; Solís, 2007).

As various works indicate (Subirats, 2016; Tomé, 2017), co-education is necessary, through the use of long-term projects and not only isolated interventions. In most cases this is already being done, since many of the proposals we analyzed are based on such long-term projects, such as "Gender @ICT" (Ferreira,

2018) , "ICT-Go-Girls" (García-Vázquez, 2014); digital mentoring programs which deconstruct gender stereotypes in Primary Education (Permoser, 2017). In addition, long-term activities by both teachers and students are also common. An example of this last case could be the construction of web spaces with which to work on a subject from a co-educational perspective (Barragán & Ruíz, 2013), or the creation of a digital newspaper. (Mérida, 2019).

Analysing the material by educational stages, Pre-school education is the one which is least examined (11%). However, it is considered to be one of the essential stages for interpersonal development. Here, there is a widespread predisposition to educate using electronic devices (Bel & Esteve, 2019; Sánchez et al., 2019), as well as to co-educate (Broch & Sanahuja, 2019; Oltra, 2019). However, there are few links between these two aspects. At this stage there is an introduction to the STEM competencies which will be continued and expanded during the later stages of education (Savinskaya, 2017), and which represents a significant leap in reducing the "digital gender gap" (Calvo, 2019).

In Primary Education, STEM competencies continue to be developed (Sullivan & Umaschi, 2018) and there is an introduction to cyber-activism (Aguilar, 2019). In addition, an important innovation is digital mentoring with which to eliminate gender stereotyping (Permoser, 2017). This strategy, also known as peer tutoring, is used at various educational levels to foster an inclusive classroom where diversity can be addressed (Moliner, 2011; Molina et al., 2019).

Cyber-activism or cyberfeminism is an important initiative in Secondary schools, and because of this, social network groups, or digital newspapers which examine gender inequality are created, (Barragán & Ruiz, 2013; Ferreira, 2017; Stuchi, 2017; Mérida, 2019). A remarkable aspect of this initiative is that these forums often represent the individual character of the institution and participants, as opposed to public social campaigns such as "# MeToo" (Thissen, 2018).

In Secondary Education there also are methods which use the inverted class, (García-Vázquez, 2014; Maldonado, 2017) and various studies demonstrate the academic and socializing potential that the inverted class can have at this level, according to Galindo and Badilla (2016).

Mobile learning is also a strategy that has proven useful for the Secondary school population (Alises, 2017) and, despite the risks of smartphone use for young people, (Villanueva, 2012), we have found a mobile application designed to reduce sexist behaviour (Navarro-Pérez et al., 2018).

As in the previous educational stages, Web 2.0 is also used in Higher Education to teach gender equality through debates or talks (Martínez-Romera, 2019). We have also found initiatives related to the development of STEM skills in engineering on technology-related courses (Barros et al., 2018; Hirata, 2018). Digital literacy and technological competence are necessities in any university education (Acuña, 2014). However, proposals to implement digital competencies in only one specific degree course do not reduce the digital gender gap.

Two proposals have also been analyzed (Pär-Ola & Faheem, 2015; Rheingans et al., 2018) that may be problematic in terms of digital and technological competences as an aspect of gender imbalance. Offering training exclusively for females could foster sexism, thus perpetuating the idea of an imbalance in terms of the capacities of each gender, and contributing to inequality latent in the hidden curriculum (Cordero, 2013; Rodríguez & Miraflores, 2018; Pacheco-Salazar & López-Yáñez, 2019). Ugalde et al. (2019) state that at first sight co-educational methodologies may be positive, but in recent years, stereotyping has occurred.

It is striking that around 75% of people studying for a degree in Education may transmit sexist beliefs to their students (Women's Institute and for Equal Opportunities, 2015). However, there are no proposals in faculties of Education to counteract this. Therefore, it is necessary to analyze the training of educators and offer specific training on gender equality through mandatory seminars, according to Carretero and Nolasco (2019).

As stated above, the vast majority of technology-related proposals are based on the social web or web 2.0, and are intended to promote a collaboration between students, which would deconstruct stereotypes and confront issues related to gender inequality. Similarly, at all the levels investigated, there are proposals to develop STEM competencies or ICT skills, from either a mixed sex or solely female perspective. Looking at the conclusions of our study, it seems to be necessary to expand on certain aspects. Firstly, it is

essential to design proposals in the form of projects that favour gender equality from a digital perspective in all formal educational contexts. The lack of literature on these topics (gender and ICT), as evidenced in the review we have presented, shows us the need to work on co-educational teaching practices and ICT. In Boix's work (2006), this idea is based on the conclusions of the 1995 "World Women's Conference" in Beijing (UN WOMEN, 1995). Other international events and subsequent official documents give us ways of working for the empowerment of women through ICTs (United Nations, 2015; UNESCO, 2006). Along these same lines, González-García and Pérez-Sedeño (2002) stress the importance of redefining curricular content and reviewing our methodologies in the field of science and technology. The 18 articles we analyzed can serve as examples of good practice with ICTs in relation to gender inequality.

As a result of the falsehoods and stereotypes rooted in feminism (García-Jiménez et al., 2016), it is not only necessary to develop transversal practices, but also a methodology which explicitly addresses gender equality (Bejarano et al., 2019).

Finally, we propose two prospective lines of research. One of them is to qualitatively broaden the proposals studied, by using interviews with the originators of these proposals. In this way, guidelines can be developed for other educational contexts. We also suggest carrying out new research to expand on teaching proposals based on the " smart classroom " or smart class (Sumadyo et al., 2018; Bdiwi et al., 2019), since this implies a restructuring of the physical space to the benefit of gender equality (Saldaña, 2018). In addition, in intelligent learning spaces, technology is a tool which could lead to the narrowing of the digital gender gap. The development of digital skills should not be directed exclusively towards females (Pär-Ola & Faheem, 2015; Rheingans et al., 2018), but should be universal. This means understanding that technologies are vital for all students, regardless of gender, and that the acquisition of existing technological competencies learned from the beginning of formal education can contribute to reducing gender inequality occuring among students at University courses in the areas of science and technology (Elizondo et al., 2010; Puy-Rodríguez, 2017).

We have a long way to go in formal education. The feedback between research and real educational experiences will combat discrimination for the benefit of a better coexistence and social equality.

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