OPEN ACCESS

CONTEMPORARY EDUCATIONAL TECHNOLOGY

ISSN: 1309-517X (Online) 2022, 14(1), ep339, https://doi.org/10.30935/cedtech/11408

Review Article

Meta-Analysis on the Attitudes of Active Teachers About the Use of Educational Technology According to Gender

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Received: 2 Sep 2021 Accepted: 18 Oct 2021

Abstract

Studies analysing and comparing the attitudes of teachers towards Information and Communication Technologies (ICT) based on gender have provided mixed results. In this work, we carried out a meta-analysis on gender differences in attitudes towards ICT, from a global perspective and exploring four dimensions: affective-emotional attitude, beliefs, self-efficacy, and mixed with each other. Through the collection of 55 studies providing 73 effect sizes based on a total sample of 21,325 working teachers, a negative effect was found, almost null (d= -0.0297) and not statistically significant. These results indicate that female teachers have a more positive attitude towards the educational use of ICT than male teachers. Independently, the dimensions affective-emotional attitude (d= -0.342), beliefs (d= 0.114), and self-efficacy (d= 0.273) produced significant effect sizes, although with small effects. The analysis of moderating variables showed that different moderators intervene significantly in the variability of effect sizes: continental origin of the teachers (emotional and beliefs dimensions); teacher's workplace (dimension self-efficacy); type of publication (emotional dimension) and validity of the instruments (emotional and beliefs dimension). With this meta-analysis, it is possible to take another step towards a better measurement and explanation of the attitudes that teachers have towards the use of new technologies in educational contexts.

Keywords: technology, education, teacher, teaching, gender, meta-analysis, research methods

INTRODUCTION

Since the emergence of new Information and Communication Technologies (ICT) and the Internet, as well as with the different Research and Innovation Framework Programs of the European Union (Horizon Report), educational processes have been reversed and transformed, causing a major revolution whereby teachers must hold a favourable and positive attitude toward ICT in order to achieve significant and relevant learning in students (Marbán & Mulenga, 2019; Njiku et al., 2019; Rodríguez-Hoyos et al., 2021).

The emergence of ubiquitous learning tools in higher education allows for more active learning, increasing debate, the exchange of ideas, immediate feedback, and easy access to digital content (Alvarado et al., 2020; Phan et al., 2021); consequently, the attitudes of male and female teachers towards these new educational technologies may vary. Given this context, and as stated by Edison and Geissler (2003, p.137), "*Technology affects everyone as it changes the fabric of society... And... While technology increasingly affects everyone,*

not all individuals view this trend as positive". Thus, it is not entirely clear whether previous research findings on the attitude of teachers towards technology are still relevant data today as they could be obsolete.

The attitude towards educational technology has raised different questions for researchers about the relationship between culture and attitude towards technology. Some relate it to the cultural and environmental conditions surrounding the individual, which shape their attitudes towards ICT and, subsequently, their use (Azmi et al., 2021; Collis, 1999; Islahi, 2019; Li & Kirkup, 2007; Zyad, 2016). In other words, there could be a symbiotic relationship between technology and society (Carpi & Iacus, 2021) since, "the creation of a technology does not occur in a vacuum but instead encompasses social and cultural phenomena" (Davies, 2004, p. 163).

Against this background, it is important to analyse the results of those studies that measure the attitudes only of active teachers towards technology, since the meta-analyses on this topic carried out by Whitley (1997), Liao (1999), and Cai et al. (2017) did not focus solely on active teachers, since they used different types of samples (elementary, secondary, and college students, employees, teachers, adults, and mixed samples, among others), so that it was not possible to identify a specific view of the attitudes towards technology of each group. Therefore, this study contributes to focusing exclusively on analysing gender differences, or the lack of thereof, in working teachers' attitudes toward educational technology.

BACKGROUND

The concept of attitude refers to an individual's behaviour regarding a particular issue, therefore it effects on a personal level (Njiku et al., 2019). Eagly and Chaiken (1998) define an attitude as *"a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour (p. 269)"*. In a technological context, attitudes towards technology could refer to feelings, likes, or dislikes toward technology (Tuncer, 2012; Vega-Gea et al., 2021). The conceptualisation of attitude has not been the same in all previous studies. Different terms can be found in the scientific literature. Each of these terms will be discussed in depth below.

Affective, Cognitive and Behavioural Beliefs

Authors such as Ostrom (1969) or Norman (1975) consider that attitudes are configured by 3 dimensions: affective, cognitive and behavioral. Affective attitudes refer to "positive or negative" feelings about an issue; cognitive attitudes are based on the beliefs that a person has learned through their life experience; and behavioural attitudes are focused on the behaviour and intention that an individual has when faced with a certain situation where they must act.

If the attitude of teachers is analysed from this prism in relation to gender, different studies did not find statistically significant differences between them (Abdelrahman et al., 2019; Bakr, 2011; Kilinc et al., 2016). These results can be interpreted as a reflection of the democratisation process of equal opportunities in access to technological infrastructure and devices in this century (Albirini, 2006). However, not all studies have corroborated this view, as some have found differences in favour of women (Alodail, 2016; Noori, 2019). According to Alodail (2016), these differential results may be due to teachers finding it difficult to change their habits to initiate themselves into a new, unknown world with a wide range of ICT resources, but that once they begin to become familiar with their use, teachers begin to realise the usefulness that they have in their daily teaching.

Emotional Attitudes

Authors such as Loyd and Gressard (1984) or Kilinc et al. (2016) have classified attitudes towards technology as emotions or feelings (positive or negative), translated in terms of anxiety, interest or taste. Technological anxiety is defined as a degree of fear or negative emotional state experienced by an individual when using technology (Bozionelos, 2001). However, there are authors who claim that both positions can be closely related, since even if a teacher thinks that technology is a positive thing, they may avoid using it because of anxiety about, contempt for, or inaccessibility of technological devices (Eichenold, 2008).

If the attitude of teachers between both genders are analysed, from the position of anxiety towards technology, several studies found significant differences (Awofala et al., 2017; Çakir, 2014; Halder & Chaudhuri, 2011; Papaioannou & Charalambous, 2011), where female teachers tend to be more nervous than male teachers. Furthermore, Chua et al. (1999), in a meta-analysis of computer anxiety found that females were generally more anxious than males; however, the study was conducted with students rather than teachers, so attitudes among this group may be different. However, not all studies agree with these results. For instance, Semerci and Aydin (2018) analysed anxiety regarding the use of ICT in education with 353 teachers, finding that there were no differences between the both genders.

Self-efficacy Towards Technology

In the study of attitudes, another variant of the term itself appears to refer to self-efficacy. Alden (1986, p. 461) states that, "efficacy concerns an individual's judgment of his or her ability to handle a situation well". In other words, the self-competence that an individual believes they possess to complete a certain task (Bandura, 1977). In technology, this refers to "a judgment of one's capability to use a computer" (Compeau & Higgins, 1995, p. 192). If beliefs about a person's self-efficacy in performing a task influence their commitment and perseverance in accomplishing it (Ünal et al., 2019), teachers' behavioural beliefs towards technology will significantly influence in the development of their digital competence (Moreira-Fontán et al., 2019).

Some studies suggest that female teachers are often considered less competent in their level of self-efficacy with technological devices (Hammack & Ivey, 2017; Sieverding & Koch, 2009). In contrast, a number of studies have found no gender effects (Scherer & Siddiq, 2015; Shapka & Ferrari, 2003).

Contribution of This Study

During the last decades, society has witnessed an accelerated integration of ICTs in all sectors of life. With each new emergence of technological resources, the attitude of individuals toward that new development or technology may vary according to their interests, tastes, emotions, beliefs, or effectiveness. In the educational field, the digital competence of teachers, and specifically their attitude towards technology, has become more important than ever, taking into consideration the health crisis we are experiencing due to COVID-19, considering the acquisition of ICT knowledge relevant for the training of students and, consequently, to train competent graduates to being professionally and effectively adapted to the 21st century labour market. With the importance that ICTs currently have in society, we argue that "either you update yourself digitally or you stay behind the times".

In the context of this research, taking into consideration the meta-analyses on gender differences in attitudes towards technology carried out by Whitley (1997), Liao (1999), and Chua et al. (1999), and given the time that has elapsed not only since the last study of this type (Cai et al., 2017) was conducted in 2017 (furthermore, in this last meta-analysis, the most current manuscript that the author used was from 2014), it is not entirely clear whether the results found are applicable at the beginning of this new decade.

The main difference of the present study with respect to other meta-analyses is that none of the previous ones has focused on analysing the gender differences associated with the technological attitude of a specific group, the teachers who are currently active, since the rest have used samples from different groups (students, future teachers who are not yet practicing, adults, among others). If technology advances by leaps and bounds, who does not claim that the teacher's attitude could also change. Furthermore, some of the moderating variables analysed in this study were not taken into consideration in most of the meta-analyses by these authors, such as the reliability and validity of the measurement instruments; and if they were taken into account, they were not analysed in depth, classifying the variables studied in a series of less exhaustive categories compared to the present study. The differences between the classification of the qualitative categories of the moderating variables analysed in this study and the rest of the meta-analyses are exposed in the discussion of the results, evidencing the contribution of this study.

Against this background, this study classifies the concept of attitude towards technology into four categories: affect, emotions (anxiety, enjoyment or interest), beliefs (affective, cognitive, and behavioural), and self-efficacy. There are many existing studies in the scientific literature in which the authors have created their own instruments to measure the concept of attitude, but they do not provide a sufficiently clear description of which category the items refer to. Therefore, in view of this situation, this type of study was classified as mixed research, following the advice of Cai et al. (2017).

The research questions addressed in this study are: (a) Are there differences in the attitudes to ICT of working teachers based on gender? (b) Are the effects of gender differences moderated by other variables, including attitudinal typology and methodological characteristics?

In order to answer these questions, the following objectives were set:

- To know if gender is a variable that moderates the effects on the global attitudes towards ICT in teachers (objective 1).
- To identify if there are different effects towards technology by gender according to the different types of attitudes (objective 2).
- To study if variables such as the continent where the study was carried out, the type of institution to which the teacher belongs, the type of publication and psychometric properties of the instruments are moderating variables of the potential relationship between attitudes towards ICT and the teacher's gender (objective 3).

METHOD

Search Strategy

The search was carried out in the following databases and web search engines: ScienceDirect, ProQuest Dissertations and Theses, PsycINFO and Google Scholar. For the search, the Boolean operators "and" / "or" were used, both in the title, abstract or keyword sections offered by the different databases. The word strings were as follows:

- Teachers' attitudes towards technology, teachers' attitude towards ICT, teachers' attitude toward computers, teachers' computer anxiety, teachers' technology anxiety, teachers' ICT anxiety, teachers' beliefs technology, teachers' beliefs computer, teachers' beliefs ICT, teacher's self-efficacy towards technology, teacher's self-efficacy towards computer, teacher's self-efficacy towards ICT.

Inclusion and Exclusion Criteria

The search period was established between January 1, 2000, and July 30, 2020. The inclusion criteria for the meta-analysis were the following:

(a) the work reflected a comparison by gender

(b) the sample used had to be active teachers

(c) information on the sample size was provided

(d) attitudes towards ICT were measured in ex post facto studies, using the mean and standard deviation or the value of the contrast statistic was provided

On the contrary, the exclusion criteria were the following:

(a) the work sample were adults, students, prospective teachers or other types

(b) a comparison was not made based on the gender of the teaching staff

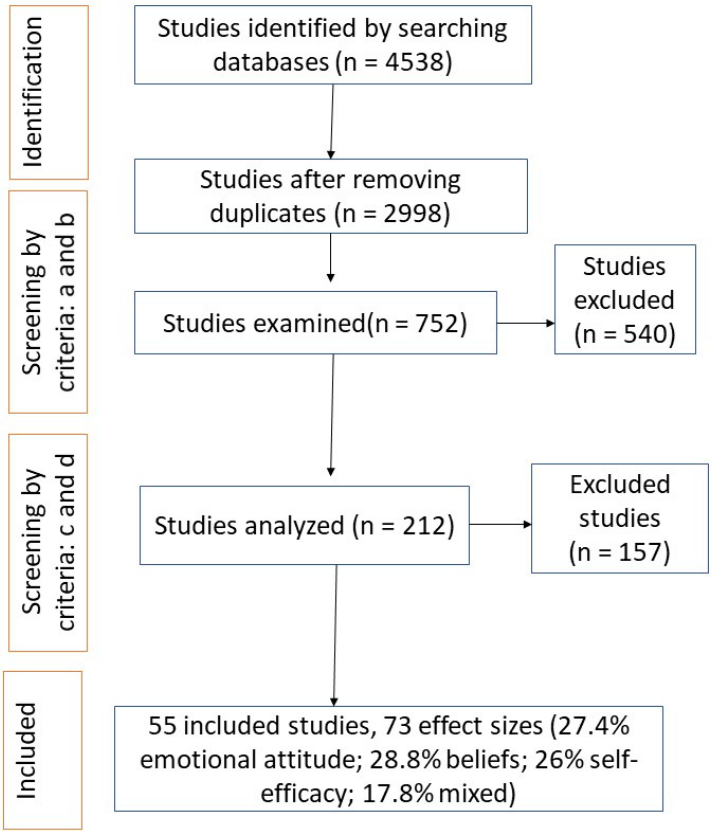

Figure 1. Flowchart of study selection

(c) (f) they were not classified in the different dimensions that make up the attitude construct: emotional affection, beliefs, self-efficacy and mixed

(d) (g) did not present the sample size, nor numerical data or the necessary statistics to calculate the effect size.

The flow chart in **Figure 1** details the steps followed, and the sample selected and excluded. These inclusion and exclusion procedures resulted in a sample of 55 studies.

Codification

In addition to the sample size (number of female and male teachers) and the information used to calculate the effect sizes, the following data were also coded for each study:

- *Type of attitude.* The attitude measurement domain was coded into four categories, as previously established by Whitley (1997) or Cai et al. (2017) in their meta-analyses: affective-emotional attitude towards ICT, beliefs towards ICT, self-efficacy towards ICT and mixed.
- *Continent.* The continent where the study was carried out was coded with four levels: America, Africa, Asia and Europe. The rest of the continents were not coded as studies of these places were not selected.
- *Decade of publication.* This variable was coded with two levels: studies published between 2000 and 2009 and studies published between 2010 and 2020.
- *Type of teaching staff*. This variable was coded with two categories: early childhood, primary or secondary education teacher and Higher Education teacher.
- *Publication format*. This variable was coded with 3 levels: articles published in scientific journals, doctoral theses and articles published at conferences.

Table 1. Magnitude of gender differences in the global attitude towards ICT and in their typologies

	N Male	N Female	N Total	k	d	Confidence interval		Heterogeneity	
						Lower	Upper	Q	I^2 (%)
Emotional	1850	3058	4908	20	-0.342*	-0.524	-0.160	106.744*	87.18
Beliefs	1843	1682	3525	21	0.114*	0.001	0.228	45.120*	57.69
Self-Efficacy	2054	2204	4258	19	0.273*	0.118	0.4298	70.237*	82.17
Mixed	4014	4620	8634	13	-0.234	-1.016	0.548	1641.07*	99.64
Total attitude	9761	11564	21325	73	-0.022	-0.189	0.145	2060.16*	96.91

Note: k represents the number of effect sizes included. * Statistically significant to 0.05

- *Psychometric properties*. These characteristics were divided into two variables, reliability and validity, and coded with two categories respectively: studies that provided data on their reliability and studies that did not provide information on their reliability; studies with at least one index on the type of exploratory or confirmatory validity or studies that did not provide any validity index.

Size of the Effect

To calculate the size of the effect, the Hedges' g formula with correction for bias (Hedges & Olkin, 1985) was used, calculated through the difference in means between two samples, and divided by the grouped standard deviation of both:

$$d = c(gl) \cdot \frac{\bar{X}_m - \bar{X}_f}{\tilde{S}}$$

In our case, $\bar{X}_m$ is the mean for male teachers, $\bar{X}_f$ is the mean for female teachers, $\tilde{S}$ is the grouped standard deviation for both genders, and *c(gl)* represents the degrees of freedom 1- (3/4-*gl*-1) where *gl* is $(n_1 - n_2 - 2)$. In those studies that did not provide the standard deviations for each sample, but did offer the contrast statistic *t*, the value of *d* was deduced. In those studies that did not offer the standard deviations of each sample, but did offer the t test statistic, the value of d was deduced. The interpretation of the effect size is as follows: the positive values for d reveal that male teachers had a greater attitude towards ICT than female teachers, while negative values show the opposite, that is, female teachers had a higher attitude. The weighted effect sizes were then calculated for each study in order to use them in the analysis of the moderator variables. Specifically, each effect size was weighted by the inverse of its variance (Lee et al., 2016). The analysis of the moderators was based on the random effects model and the homogeneity of the mean effect size was verified with Cochran's Q statistic (DerSimonian & Laird, 1986). The software used were JAMOVI and Comprehensive Meta-Analysis (CMA) v3.

RESULTS

Size of the Overall Effect and Variation Between Attitude Typologies

Table 1 shows the overall effect size for both the attitude construct and its different types. Following Cohen's (2013) classification, the effect size values usually ranged between ±3 along with their respective confidence intervals. According to the author, effect sizes of 0.2, 0.5, and 0.8 represent a small, medium, and large effect, respectively. Regarding the overall attitude of teachers, and for the 73 independent effect sizes of this study, a negative effect was found, almost null (not statistically significant, $p > .05$), in favour of female teachers, where d = -0.022 with a 95% confidence interval of -0.189 to 0.145.

To better understand the overall effect sizes found, we could compare these results with the findings of previous studies related to the topic. For example, in the meta-analyses by Cai et al. (2017), Liao (1999) Whitley (1997) small and medium overall effect sizes were found, all significant, in attitudes towards technology in favour of male individuals (d = 0.17; d = 0.19; d = 0.232), respectively, and all significant. As previously commented, such differences in attitudes towards technology with respect to gender may have been due to the type of sample used. For example, Cai et al. (2017) used students, teachers, employees, and web users, in their study; while Whitley (1997) and Liao (1999) used adults, university students, high school

students, primary school students, or a mixed population. Compared to the current study, which used only active teachers, no differences were found in overall attitudes towards educational use of ICT, corroborating the findings of Abdelrahman et al. (2019), Bakr (2011), Kilinc et al. (2016), and Zyad (2016). The explanation for not finding significant differences between both genders could be twofold: on the one hand, the democratisation process currently underway in terms of equal opportunities (Albirini, 2006), and, on the other, and easy access to digital content (Alvarado et al., 2020).

If each dimension of the attitude construct is analysed separately, because the conceptualisation of the term has been studied using different approaches, three significant effect sizes are found, for the emotional dimensions, and self-efficacy. For the emotional attitude dimension, a small to medium effect size was found (d = -0.342, p < .05), in favour of female teachers (with higher scores for female teachers), while for the other two dimensions, males showed a more positive and favourable attitude in terms of direction (beliefs: d = 0.144, p < .05; self-efficacy: d = 0.273, p < .05).

To check whether the effect sizes estimated the same population parameter, a heterogeneity test was performed on those dimensions that had a significant effect size (emotional, beliefs, and self-efficacy). The Q statistic showed variability and significance in the analysed studies, rejecting the hypothesis of homogeneity. The values obtained were the following: attitude emotional Q= 106.744, p < .05, beliefs Q= 45.120, p < .05, and self-efficacy Q= 70.237, p < .05. These values of Q indicate the existence of real differences in the effect sizes between samples (heterogeneity), reaffirming that this was due to the diverse nature of the studies, which indicates the need to carry out an analysis of moderating variables that can explain this variability in effect sizes.

The Q statistic informs us about the existence or not of significant heterogeneity, but not about the degree of such heterogeneity. Therefore, we calculated the I^2 index (Higgins et al., 2003), which informs us about the degree of true heterogeneity of the effect sizes. Coefficients of around 25%, 50%, and 75%, can be interpreted as low, moderate, and high heterogeneity, respectively. Therefore, the values of the I^2 statistic suggested that between 57% and 87% of the variability in each of the dimensions analysed could be attributed to true heterogeneity rather than random error (emotional, I^2= 87.18%; beliefs, I^2= 57.69%; self-efficacy, I^2= 82.17). For this reason, an analysis of moderating variables was performed following the random effects model.

If we compare the findings of this study with previous studies, a certain similarity but also a discrepancy can be observed, depending on the dimension analysed, in terms of direction. With regard to emotional attitudes related to anxiety, fun or enjoyment of the use of technology, authors such as Whitley (1997), and Cai et al. (2017) found significant and positive effect sizes (d = 0.259 and d = 0.100, respectively) in favour of the male sex, which would go against those obtained in our study, where we have found a higher score in female teachers. These results may be associated with multiple factors: on the one hand, the percentage of studies included in the current meta-analysis focusing on anxiety towards technology with respect to the total number of studies of this dimension (70%), corroborating the results of Awofala et al. (2017), Çakir (2014), Halder and Chaudhuri (2011), and Papaioannou and Charalambous (2011), and who found that female teachers tend to be more nervous when working with technological devices or resources. That is, if one takes into consideration that most studies measure anxiety and that the female sex has obtained a higher score compared to the male sex, it could be interpreted that the favourable activity is for the male sex. And, on the other hand, the methodological design of the studies included in these authors' meta-analyses, as this attitude construct analyses different types of emotions that can be interpreted as positive or negative attitudes (anxiety or fun), meaning that, depending on what the authors measured, the size of the effect could move in one direction or another.

Regarding beliefs, studies such as those by Liao (1999), and Whitley (1997) found a very small effect (d = 0.020 and d = 0.065, respectively), while Cai et al. (2017) found a small effect (d = 0.27). These results corroborate the coefficients found in this study, both in the value of the effect size, being small, and in the direction of the effect, being a positive effect. It could therefore be said that all these studies agree that the male sex tends to have more favourable beliefs regarding the use of technology than the female sex. These

results are consistent with the statements by Alodail (2016) that, although *a priori* there may be differences in attitudes towards technology, once teachers have the initiative to become involved in the world of technology, the discrepancies in levels with regard to gender decrease, with very small significant differences being found. Regardless of the differences in ex, it must be taken into consideration that, in this type of construct, as Ajzen (2005) states, beliefs refer to negative or positive perceptions of an issue, so the combination of both elements could dilute the gender difference. For example, the study by Bakr (2011) found one negative effect (d = -0.42) for the affective dimension and two positive effects for the cognitive and behavioural dimensions (d = 0.12; d = 0.07). Therefore, in future works, the study of beliefs towards technology should provide both positive and negative items separately, as well as affective, cognitive, and behavioural categories, corroborating Whitley's (1997) conclusions.

With regard to self-efficacy, the effect found in this meta-analysis (d = 0.273) is greater than the effect identified by Cai et al. (2017; d = 0.18) and less than the effect found by Whitley (1997; d = 0.41). However, in all three studies, both the size of the effect (small effects), and in the direction of it (self-efficacy towards the higher technology in male teachers) are similar, corroborating the results of other studies (Hammack & Ivey, 2017; Sieverding & Koch, 2009). In view of these findings, we agree with the contributions of Ünal et al. (2019) when they state that self-efficacy is a key element in the development of digital teaching competence, closely linked to self-efficacy and behavioural beliefs in regard to the use of technology. Therefore, it must be a priority objective to achieve the commitment and perseverance of teachers in the use of technology, mainly among the female ex, and, in this way, to reduce the existing digital divide.

Table 2 shows the individual effect size for each study included in the meta-analysis.

Table 2. Individual studies included in the meta-analysis

Study	Sample		Attitude	Continent	Place of work	Publication	R	V	d	Std Err
	M	F								
Abdelrahman et al. (2019)	179	41	B	Asia	University	Journal	Yes	No	-0.29	0.173
Ahmad (2000)	55	193	E	USA	Prim. / Sec.	Thesis	No	No	0.16	0.153
Ahmad (2000)	55	193	E	USA	Prim. / Sec.	Thesis	No	No	0.14	0.153
Al-Ghazo (2008)	142	19	B	USA	University	Thesis	Yes	No	0.07	0.243
Alqahtani (2019)	68	40	SE	USA	Primary	Thesis	Yes	No	0.22	0.198
Alrasheedi (2009)	82	85	B	USA	Secondary	Thesis	Yes	Yes	0.37	0.155
Alzamil (2003)	99	84	B	USA	Secondary	Thesis	Yes	No	-0.04	0.148
Alzidiyeen et al. (2011)	242	223	E	USA	Primary	Journal	Yes	No	-0.34	0.093
Alzidiyeen et al. (2011)	242	223	SE	USA	Primary	Journal	Yes	No	0.29	0.093
Akcay et al. (2015)	189	71	M	Asia	University	Journal	Yes	No	0.75	0.143
Annaraja & Joseph (2006)	13	18	E	Asia	University	Journal	No	No	-0.44	0.359
Arques (2013)	104	106	M	Europe	Prim. / Sec.	Thesis	Yes	Yes	0.18	0.138
Bakr (2011)	53	65	B	Africa	Secondary	Journal	No	No	-0.42	0.186
Bakr (2011)	53	65	B	Africa	Secondary	Journal	No	No	0.12	0.184
Bakr (2011)	53	65	B	Africa	Secondary	Journal	No	No	0.07	0.184
Bas & Senturk (2018)	93	107	SE	Asia	Prim. / Sec.	Journal	No	No	0.08	0.141
Bektas (2016)	85	86	SE	Asia	Child. / Prim.	Congress	Yes	Yes	0.31	0.153
Birgin et al. (2020)	121	121	SE	Asia	Prim. / Sec.	Journal	Yes	Yes	0.08	0.128
Burke (2014)	40	157	SE	USA	Child. / Prim./ Sec.	Thesis	Yes	No	0.38	0.177
Çakir (2014)	287	481	E	Asia	Child	Journal	Yes	Yes	-0.53	0.076
Çakir (2014)	287	481	E	Asia	Child	Journal	Yes	Yes	-0.58	0.076
Cavas et al. (2009)	507	664	M	Asia	Primary	Journal	Yes	No	-0.07	0.059
Chou (2003)	71	65	E	Asia	Secondary	Journal	Yes	Yes	-0.94	0.180
Deniz (2007)	19	71	E	Asia	University	Journal	Yes	No	-0.03	0.256
Deniz (2007)	19	71	E	Asia	University	Journal	Yes	No	-0.52	0.259
Denson (2005)	34	114	B	USA	Secondary	Thesis	Yes	No	-0.06	0.194
Embi (2007)	76	186	E	USA	University	Thesis	Yes	No	-0.03	0.136
Embi (2007)	76	186	SE	USA	University	Thesis	Yes	No	0.14	0.136

Note: Sample= *Male (M), Female (F).* Type of attitude = Emotional (E), Beliefs (B), Self-efficacy (SE), Mixed (M). Place of work= Child (Early Childhood Education), Prim. (Primary), Sec (Secondary). Reliability (R). Validity (V). Effect size (d)

Table 2 (continued). Individual studies included in the meta-analysis

Study	Sample		Attitude	Continent	Place of work	Publication	R	V	d	Std Err
	M	F								
Fernández & Bermejo (2012)	25	38	B	Europe	Secondary	Journal	Yes	Yes	0.54	0.259
González et al. (2017)	444	778	M	Europe	Prim. / Sec.	Journal	No	No	-3.46	0.092
Halder & Chaudhuri (2011)	43	41	E	Asia	Secondary	Congress	No	No	-1.21	0.256
Halder & Chaudhuri (2011)	43	41	SE	Asia	Secondary	Congress	No	No	1.78	0.236
Helms (2004)	9	32	SE	USA	Prim. / Sec.	Thesis	Yes	No	0.45	0.373
Hong & Koh (2002)	112	88	E	Asia	Secondary	Journal	Yes	Yes	-0.41	0.143
Hong & Koh (2002)	112	88	B	Asia	Secondary	Journal	Yes	Yes	0.26	0.143
Islahi (2019)	245	237	M	Asia	Secondary	Journal	Yes	No	0.15	0.091
Jegede (2007)	146	72	SE	Africa	Secondary	Journal	No	No	-0.03	0.144
Johnson (2001)	64	67	M	USA	University	Thesis	No	No	-0.39	0.175
Kabataş & Karaoğlan (2018)	111	101	SE	Asia	Mixed	Journal	No	No	-0.25	0.138
Kagima & Hausafus (2000)	111	65	SE	USA	University	Journal	Yes	No	0.34	0.157
Kahraman & Yilmaz (2018)	143	206	SE	Asia	Mixed	Journal	Yes	Yes	0.01	0.109
Kemp (2002)	252	173	B	USA	Secondary	Thesis	No	No	0.23	0.099
Kemp (2002)	252	173	SE	USA	Secondary	Thesis	No	No	0.22	0.099
Kiliç (2015)	48	76	E	Asia	Prim. / Sec.	Journal	Yes	No	-0.76	0.189
Kiliç (2015)	48	76	SE	Asia	Prim. / Sec.	Journal	Yes	No	0.70	0.189
Kilinc et al. (2016)	67	78	B	Asia	Secondary	Journal	Yes	No	-0.16	0.166
Kilinc et al. (2016)	67	78	E	Asia	Secondary	Journal	Yes	No	-0.14	0.166
Kpolovie & Awusaku (2016)	251	149	B	Africa	University	Journal	Yes	Yes	0.17	0.103
Kretschmann (2015)	26	31	B	USA	Secondary	Journal	No	No	-0.16	0.263
Lin et al. (2013)	94	130	SE	Asia	Secondary	Journal	Yes	Yes	0.46	0.137
Noori (2019)	27	26	B	Asia	University	Journal	Yes	No	0.45	0.274
Olafare et al. (2018)	38	85	M	Asia	University	Journal	No	No	-0.07	0.060
Olafare et al. (2020)	123	130	M	Africa	Secondary	Journal	Yes	No	-0.06	0.125
Olanrewaju et al. (2020)	97	21	M	Africa	University	Journal	Yes	No	2.24	0.280
Onasanya et al. (2010)	90	60	M	Africa	University	Journal	Yes	No	-2.83	0.233
Öztürk (2018)	88	80	E	Asia	Primary	Journal	Yes	Yes	-0.39	0.155
Pavlou & Vryonides (2009)	157	293	M	Europe	Prim. / Sec.	Journal	Yes	Yes	0.35	0.099
Sarfo et al. (20017)	229	178	SE	Africa	University	Journal	Yes	No	0.26	0.100
Semerci & Aydin (2018)	150	203	B	Asia	University	Journal	Yes	No	-0.04	0.107
Semerci & Aydin (2018)	150	203	E	Asia	University	Journal	Yes	No	-0.15	0.108
Simsek (2011)	38	85	E	Asia	Prim. / Sec.	Journal	Yes	No	-0.51	0.194
Simsek (2011)	38	85	SE	Asia	Prim. / Sec.	Journal	Yes	No	0.06	0.197
Tezci (2010)	696	844	M	Asia	Primary	Journal	Yes	Yes	0.03	0.051
Tezci (2010)	696	844	M	Asia	Primary	Journal	Yes	Yes	0.16	0.051
Tweed (2013)	80	44	SE	USA	Child /Prim.	Thesis	No	No	0.28	0.187
Valdés-Cuervo et al. (2011)	56	92	B	Europe	Primary	Journal	Yes	Yes	0.48	0.171
Velasquez (2002)	83	197	B	USA	Prim. / Sec.	Thesis	Yes	No	-0.02	0.131
Williams (2006)	25	154	E	USA	Primary	Thesis	No	No	0.72	0.218
Williams (2006)	25	154	E	USA	Primary	Thesis	No	No	-0.81	0.219
Yehya et al. (2019)	105	36	E	Asia	Secondary	Journal	No	No	-0.18	0.192
Zyad (2016)	33	23	B	Africa	Secondary	Journal	No	No	0.02	0.268
Zyad (2016)	33	23	B	Africa	Secondary	Journal	No	No	0.89	0.281
Zyad (2016)	33	23	B	Africa	Secondary	Journal	No	No	0.44	0.271

Note: Sample= *Male (M), Female (F).* Type of attitude = Emotional (E), Beliefs (B), Self-efficacy (SE), Mixed (M). Place of work= Child (Early Childhood Education), Prim. (Primary), Sec (Secondary). Reliability (R). Validity (V). Effect size (d)

Analysis of Moderators

Table 3 presents the categorical moderator analyses, following the mixed effects model, of the following variables: continent, teacher's workplace, decade in which the studies are published, type of publication, and psychometric properties, both for the global attitude and for its typologies (those in which significant effect sizes were found: emotional, beliefs and self-efficacy – see **Table 1**).

Table 3. Moderator analysis for variation in gender differences in attitude towards ICT

	Emotional			Beliefs			Self-Efficacy		
	k	d	CI 95%	k	d	CI 95%	k	d	CI 95%
Continent									
Asia	14	-0.48*	(-0.62, -0.33)	5	0.01	(-0.21, 0.24)	9	0.32*	(0.04, 0.60)
Africa				7	0.15	(-0.12, 0.42)	2	0.13	(-0.15, 0.42)
USA	6	-0.03	(-0.36, 0.30)	7	0.09	(-0.10, 0.23)	8	0.26*	(0.17, 0.36)
Europe				2	0.50*	(0.22, 0.78)			
Q_B		(5.95)*			(7.98)*			(0.97)	
Work									
School	15	-0.38*	(-0.57, -0.20)	16	0.14*	(0.01, 0.28)	15	0.30*	(0.13, 0.47)
University	5	-0.15*	(-0.30, -0.01)	5	0.04	(-0.16, 0.24)	3	0.24*	(0.10, 0.38)
Q_B		(3.72)			(0.68)			(4.51)*	
Decade									
2000-2009	10	-0.21	(-0.51, 0.09)	7	0.14*	(0.01, 0.26)	5	0.18*	(0.06, 0.31)
2010-2020	10	-0.45*	(-0.60, -0.30)	14	0.12	(-0.05, 0.28)	14	0.30*	(0.13, 0.47)
Q_B		(2.06)			(0.85)			(1.13)	
Publication									
Journal	14	-0.43*	(-0.55, -0.31)	15	0.13	(-0.03, 0.28)	11	0.17*	(0.04, 0.31)
Conferences	1	-1.21*	(-1.67, -0.75)				2	1.03	(-0.40, 2.46)
Thesis	5	0.04	(-0.34, 0.42)	6	0.11	(-0.03, 0.25)	6	0.24*	(0.12, 0.36)
Q_B		(16.83)*			(0.89)			(1.75)	
Reliability									
No	7	-0.22	(-0.67, 0.23)	8	0.13	(-0.11, 0.36)	6	0.30	(-0.08, 0.68)
Yes	13	-0.41*	(-0.54, -0.28)	13	0.11	(-0.02, 0.24)	13	0.26*	(0.16, 0.35)
Q_B		(0.65)			(0.02)			(0.05)	
Validity									
No	15	-0.26*	(-0.46, -0.06)	16	0.03	(-0.09, 0.16)	15	0.29*	(0.12, 0.49)
Yes	5	-0.55*	(-0.68, -0.42)	5	0.29*	(0.17, 0.42)	4	0.21	(-0.01, 0.42)
Q_B		(5.99)*			(8.10)*			(0.35)	

Note. k= number of studied being included, d= effect size, CI 95% = Wald's confidence interval 95%, Q_B= inter-category homogeneity

With regard to the first characteristic (continent), the statistic Q_B indicated that the average effect sizes between some continents varied when significant differences were found. Specifically, in the emotional (Q_B (2) = 5.95; $p < .05$) and belief (Q_B (4) = 7.98; $p < .05$) dimensions it was observed that the continent variable explained part of the variability in the effect sizes, where gender differences were higher in samples from Asia (emotional dimension, d = -0.48) and in samples from Europe (beliefs dimension, d = - 0.50). These differences between continents may be due to the fact that the curricular integration of technology is not carried out in the same way, depending on the social and cultural phenomena of each continent (Davies, 2004). The results found are corroborated in part by Cai et al. (2017) since the authors not only found significant differences in the emotional dimensions and beliefs, but also in the self-efficacy dimension, as well as in the global attitude. If the results are compared with those of Liao (1999), the findings are contradictory since they did not find significant differences according to the place of origin. Perhaps a possible explanation is due to the fact that this author only divided the sample into participants from and not from the United States. Finally, it is not possible to compare the results with those of the meta-analysis by Whitley (1997) since this variable was not analysed.

The moderating variable workplace of teachers does not seem to affect the variability in gender differences of the effect sizes analysed in the emotional and beliefs dimensions, except in the self-efficacy dimension (Q_B (2) = 4.51; $p < .05$). The results found are contradictory to those reached by Cai et al. (2017) which did find significant differences in the emotional dimensions and beliefs and not in the self-efficacy dimension. If the results are compared with Whitley (1997), we find similarity in the results for the belief and self-efficacy dimensions and contradictory for the emotional dimension. Between both authors, the results of this study are closer to those found by Whitley (1997) with respect to those of Cai et al. (2017). Perhaps a possible explanation for these findings is due to the fact that these authors used different types of samples, including

students, teachers or others, while in our study we only included active teachers, so the validity of our results is more extrapolated to the population under study. Finally, it is not possible to compare the results with those of Liao (1999) since this variable was not analyzed.

With regard to the results found regarding the moderator 'decade', these are in line with the results of Cai et al. (2017), Liao (1999), and Whitley (1997), who analysed the correlation between the attitude towards technology and the date of publication, not finding a significant relationship. The difference in and contribution of our study is the further classification of the studies, both by decade and typology of attitude, while the other two studies only performed analysis at a global level.

It was tested whether the magnitude of gender differences in attitudes towards ICT varied according to the type of publication. There is evidence that supports significant differences between publication types, in the emotional (Q_B (3) = 16.83; $p < .05$). The effect sizes in the emotional dimension varied from -1.21 (conferences) to 0.04 (thesis). These results are contradictory to those of Liao (1999) and are partially corroborated with the findings of Cai et al. (2017) when finding that the moderating variable type of publication explained part of the variability of the gender differences in the effect sizes of the emotional dimension, but contradictory with the self-efficacy dimension since the author did find significant differences. The main contribution of this study with respect to the other meta-analyses is that Whitley (1997) did not analyse this moderating variable and Cai et al. (2017) only distinguished between journal articles and doctoral theses, while this study also includes articles published at conferences.

With respect to the psychometric properties of the studies (reliability and validity), according to our results, the moderating variable reliability does not affect the variability in effect sizes, there being no differences between those studies that do provide these methodological characteristics and the studies that do not provide this information, corroborating the results of Liao (1999). However, significant differences were found in the validity variable in the emotional dimension (Q_B (2) = 5.99; $p < .05$) and beliefs dimension (Q_B (2) = 8.10; $p < .05$). For example, it is observed that the largest effect size in the validity variable is found in those studies that did carry out and included this type of psychometric properties compared to those that did not provide this evidence. These results are relevant since the other meta-analyses did not carry out this type of analysis.

The results obtained suggest that the territory where the integration of ICT was carried out, the teacher's workplace, type of publication, as well as the validity of the instruments can explain part of the differences in the attitude of teachers towards technology linked gender, in some of the dimensions analysed. One possible explanation for the significance of the territory was provided by Collis (1999), Davies (2004), and Li and Kirkup (2007), as discussed above; however, one must ask: why in the initial stages is there a greater difference in attitudes towards technology regarding the effectiveness that teachers believe they have? Is it because there is a gradual relationship in the level of attitude depending on whether the teacher is in initial or higher stages? Are studies with greater scientific rigor carried out according to the type of publication? Does the peer review carried out by journal, congress or doctoral thesis supervisors affect the design of the research, and consequently, the gender differences? Why are significant differences found when the validity of the instrument is checked, but not when the reliability is checked? This type of question requires a greater depth in this type of study.

CONCLUSIONS

In this meta-analysis, we have provided further evidence of gender differences in teachers' attitudes to ICT, and different moderators have been shown to play a significant role in the variability of effect sizes. The results of this meta-analysis indicate that, in general, there are no significant gender differences; however, some differences in the emotional, beliefs, and self-efficacy dimensions of attitude were found. The significant differences between the effect sizes in each of the dimensions analysed are quite interesting, and more researches are needed to address the objective of this study, as the direction of the attitude towards gender may vary depending on how the studies have been designed, and what type of attitude is measured.

The results found may have several implications at the educational and research level, from the perspective of the educational institution, in order to focus on training actions in those constructs and gender that present less favourable attitudes towards the use of educational technology, to the methodological perspective, on the importance of well-designed studies with complete sampling procedures and psychometric quality.

Furthermore, our study provides some evidence that the moderators continent, workplace, type of publication and instrument validity can produce inequalities in the effect sizes of gender differences. Nonetheless, it remains unknown what other factors can contribute to explaining the variability of significant effects. In addition, it should be pointed out that there are certain limitations to this meta-analysis, as there are few studies from different continents – in particular there is a lack of studies in Oceania – and studies published in different media, such as congresses. This information is useful in itself.

In conclusion, the study of the attitudes towards ICT of active teachers will allow innovative teachers and scientific researchers to continue designing training programs that contribute not only to their acquisition and development in teachers, but also to their own integration into the teaching profession. teaching-learning processes, with the purpose of being able to provide a higher quality education. With this meta-analysis, it is possible to take an important step towards a better measurement and understanding of the attitudes towards ICT of active teachers, according to gender.

Author contributions: All authors were involved in concept, design, collection of data, interpretation, writing, and critically revising the article. All authors approve final version of the article.

Funding: The authors received no financial support for the research and/or authorship of this article.

Declaration of interest: Authors declare no competing interest.

Research involving human participants and/or animals: Authors declare that the study has not been carried out with human or animal participants.

Informed consent: Authors declare that they have not used human samples, so they have not had to request consent.

Data availability: Data generated or analysed during this study are available from the authors on request.

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