

A meta-analysis of gender differences in e-learning outcomes

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Research Article

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Abstract

The new century has been witnessing a rapid development of information technologies, along with which e-learning has been increasingly popularized especially in this special pandemic time. This study, including 20 high-quality publications, meta-analytically examined gender differences in e-learning outcomes, e.g. e-learners' self-efficacy, satisfaction, motivation, attitude, and performance, across the world. The study concludes that there are generally no significant gender differences in e-learning outcomes except in a few countries. For example, females significantly outperformed males in Spain and the UK. In Austria, India, and mixed countries (Chile and Spain), females hold significantly more positive attitudes towards e-learning than males. In the USA, females present significantly higher self-efficacy than males. Future research into the gender issue in e-learning across the world may adopt cross-disciplinary research methods except for a meta-analysis.

Introduction

With rapid development of science and technology, the new century has been witnessing growing self-efficacy, satisfaction, motivation, attitude, and performance among e-learners (Thompson, Meriac, & Cope, 2002).

Self-efficacy

Previous studies reported significant differences in e-learning self-efficacy (e.g. Chen & Tsai, 2007). Self-efficacy in e-learning, positively influencing e-learning effectiveness (Hsu & Chiu, 2004), is operationally defined as the individual evaluation of the e-learning experience and the individual ability to complete a given e-learning task (Torkzadeh & Van Dyke, 2002). Presence of males can lead to significantly higher self-efficacy than females (Baylor & Kim, 2004). Learners with higher self-efficacy could be able to obtain more knowledge by focusing on online resources, perform better by spending more time and be more motivated to engage in e-learning than those with lower self-efficacy (Pituch & Lee, 2006). Females, with lower self-efficacy, tend to be more subject to unskillful use of e-learning technology than males in China (Ong & Lai, 2006). Compared with males, females in China tend to increase their self-efficacy dependent on their family support, which indicates that e-learning is closely related to social contexts of genders rather than sex itself (Chu, 2010).

Motivation and satisfaction

Previous studies have provided contradictory findings regarding gender differences in e-learning satisfaction and motivational gender difference has generally not been revealed in Malaysia (Marimuthu, Chone, Heng, Nah, & Fen, 2013). No significant gender differences have been revealed in e-learning motivation and satisfaction although e-learning through the mobile platform - Moodle may positively influence e-learning satisfaction and motivation for both males and females in Spain and the UK (Cuadrado-García, Ruiz-Molina, & Montoro-Pons, 2010). No significant effect of gender and age on e-learning readiness or satisfaction has been revealed in Hong Kong, China (So & Swatman, 2010). There is

no significant gender difference in e-learning motivation (Yukselturk & Bulut, 2009). There are also other studies reporting no significant gender differences in satisfaction (e.g. Ramírez-Correa, Arenas-Gaitán, & Rondán-Cataluña, 2015) with and attitudes towards the e-learning approach (e.g. Cuadrado et al., 2010; Hung, Chou, Chen, & Own, 2010) although Hong (2002) argues that gender plays an important role in e-learners' satisfaction.

Nevertheless, it is reported that females, planning learning schedules and interacting with instructors more effectively, tend to be more satisfied with e-learning courses than males among mixed participants in Spain and the UK (González-Gómez, Guardiola, Martín Rodríguez, & Montero Alonso, 2012). Females consider e-learning effective and are thus more satisfied with it than males (Hu & Hui, 2011) although e-learning motivation of females is significantly lower than that of males (Hu & Hui, 2011). Reverse findings were found by Lu and Chiou (2010) who reported that males were more satisfied with e-learning than females. Social presence in e-learning could improve learners' motivation and satisfaction (Thayalan, Shanthi, & Paridi, 2012). Males feel significantly more enjoyable and satisfied with e-learning via video models (Hoogerheide, Loyens, & Van Gog, 2016).

Performance

Previous studies have arrived at inconsistent conclusions regarding the gender differences in e-learning performance (Price, 2006; Marimuthu, Chone, Heng, Nah, & Fen, 2013). No gender differences were revealed in e-learning performance (Chen & Tsai, 2007). Gender has also been considered an insignificant influencing factor in e-learning performance (Yukselturk & Bulut, 2009). However, gender differences were found in use of technology, e-instruction, technology skillfulness, and information literacy (Aydin, 2011). Besides, social presence in e-learning could decrease the dropout rate (Cobb, 2009) and improve learners' e-learning performance such as critical thinking (Garrison, Anderson, & Archer, 2000) and online communications (Danchak, Walther, & Swan, 2001). E-learning performance has been demonstrated subject to several factors, e.g. motivation and learning strategies, computer competence, perceptions about discussion, critical thinking, peer learning, problem-based learning, interaction, and available help in a Chinese educational context (Zhu, Valcke, & Li, 2009).

Gender is, however, not considered a factor that influences e-learning performance. There is no significant gender difference in language performance, while females show significantly higher self-efficacy than males (Harb, Bakar, & Krish, 2014). No gender difference has been found in e-learning via video modeling examples and both males and females experience an enhanced self-perceived competence after this e-learning model (Hoogerheide, Loyens, & Van Gog, 2016).

Attitudes

Gender differences in attitudes toward e-learning are generally insignificant although there are some different arguments. Students, whether males or females, hold positive attitudes towards the e-learning platform - e-HO in China (Lee, Pan, & Liao, 2011). Gender does not exert a significant influence on attitudes towards e-learning (Chen & Tsai, 2007). Little evidence has been found regarding gender

differences in attitudes towards e-learning system (Albert & Johnson, 2011). However, significant gender differences have been reported by some researchers (e.g. Jackson, Ervin, Gardner, & Schmitt, 2001; Shashaani & Khalili, 2001). Males tend to hold more positive attitudes (Whitely, 1997) toward e-learning and Chinese learners are more voluntary to access e-learning (Ong & Lai, 2006). Male university students prefer to use e-learning compared with females (Reda & Dennis, 1992). Males tend to hold more favorable attitudes towards e-learning than females and the latter hold more computer anxiety than the former (Keller et al., 2007) in Sweden and Lithuania. Females hold significantly more positive attitudes toward and are more interested in e-learning medical course with Moodle than males (Harreiter, Wiener, Plass, & Kautzky-Willer, 2011).

However, others found no gender differences in attitudes toward e-learning. They held that the superficial gender differences in attitudes may be caused by different social statuses, economic states and preferences rather than sex itself (e.g. Bimber, 2000) and gender differences in the attitude have been minimized with the rapid popularization of e-technologies and equally easy access to e-learning (Hanauer, Dibble, Fortin, & Col, 2004; Papastergiou & Solomonidou, 2005). For both genders, attitudes towards e-learning are positively correlated with their satisfaction in Cyprus, Thailand and other countries (Vate-U-Lan, 2020). No significant gender differences among university faculty and students have been found in attitudes toward information and communication technology assisted learning in a university in India (Verma & Dahiya, 2016). Chinese learners' attitude towards use of e-learning indicates the intention to use e-learning methods (Ong & Lai, 2006). No significant behavioral intention of e-learning has been identified between male and female instructors in Jordan (Altawallbeh, Thiam, Alshourah, & Fong, 2015).

Based on the review of literature, the research question proposed is "are there any gender differences in e-learners' self-efficacy, satisfaction, motivation, attitude, and performance across the world?"

Methods

This meta-analysis is implemented on the basis of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2009). The review board waived the review protocol registry due to the characteristics of this study.

Eligibility criteria

The studies will be included if they (1) focus on gender differences in e-learning outcomes rather than e-learning technology itself, (2) are of high quality based on University of West England Framework for Critically Appraising Research Articles (Moule et al., 2003), (3) adopt a randomized controlled design where a control and experiment group is comparatively analyzed, (4) can provide enough data for a meta-analysis, and (5) are written in English.

The studies will be excluded if they (1) focus on e-learning technology itself rather than e-learning outcomes, (2) are not rigidly designed using randomized controlled design, (3) are written in a language

other than English, (4) cannot provide enough data for the meta-analysis even after corresponding with the authors, or (5) themselves belong to review studies.

Data sources and search strategy

To avoid duplication of this meta-analysis, we searched multiple databases e.g. the Cochrane Databases of Systematic Review, the Centre for Review and Dissemination, Taylor & Francis Group, Sage Publications, Springer Nature, Web of Science, Science Direct, EBSCO, and Educational Research Complete. To include as comprehensive literature as possible, we considered both published and unpublished literature written in English without time limitation. We included those ranging from their inception to February 10, 2021.

We adopted a three-step search strategy. Firstly, we selected numerous databases such as Scopus, Taylor & Francis Group, Sage Publications, Springer Nature, Web of Science, Science Direct, Ebsco, Proquest, and Educational Research Complete. Secondly, we comprehensively searched the literature by entering corresponding terms into various databases and obtained results containing a sea of literature. Thirdly, we read through the literature to prevent duplication by optimizing the results.

The selection process of literature was implemented based on the PRISMA flowchart (Figure 1). Firstly, the obtained results were entered into the software Endnote X8 (Thomson Reuters, New York, USA) for duplication identification and removal. Secondly, two reviewers screened the irrelevant literature by perusing abstracts, keywords, and titles, etc. Thirdly, both reviewers independently evaluated the literature for eligibility based on University of West England Framework for Critically Appraising Research Articles (Moule et al., 2003). Fourthly, both reviewers met together to decide the final selection. In case both reviewers cannot reach an agreement on any selected literature, a third reviewer will join and determine the selection.

Quality assessment

The University of West England Framework for Critically Appraising Research Articles (Moule et al., 2003) evaluates each article in terms of five sections, i.e. *The Introduction*, *The Methods Section*, *Ethics*, *The Results/Findings*, and *the Conclusions*. Each section is evaluated based on a given criterion. For example, as for the introduction part, reviewers will evaluate it by proposing criteria such as whether there is a clear statement about the topic being investigated and whether there is a clear rational for the research. As for the methods section, reviewers will evaluate it based on four criteria, i.e. (1) The research design should be clearly described; (2) The research methods should be appropriate for the topic being investigated; (3) The researchers should acknowledge the advantages or disadvantages of the design; (4) There should be a clear statement about how the participants were selected. Each article will be scored based on the criteria. Those top scored will be included for the meta-analysis. The results/findings section require that the results be related to the literature review and the researchers acknowledge the limitations of the research design. In the conclusion section, the researchers should acknowledge the implications for

future research, identify areas for further research, and propose recommendations for practice from the results or discussions.

Data extraction

Both reviewers will extract specific data from the included studies. The extracted data include total numbers of participants, means, and standard deviations in both control and experimental groups, levels of education of participants, modes of e-learning, countries where the study was conducted, e-learning outcomes (e-learners' attitudes, motivation, performance, satisfaction, and self-efficacy), and data collection methods. In case the data are not enough for the meta-analysis, we will correspond with the authors. The study will be removed if we finally fail to obtain enough data for the meta-analysis. The main extracted data are shown in Table 1.

Statistical analysis

We conducted the meta-analysis generally through Stata MP/14.0. Specifically, we entered related data into Stata MP/14.0 to calculate standard mean differences (SMD) or Cohen d , the lower and upper bounds of 95% confidence intervals, weights, distribution of individual studies, Q data, heterogeneity, I^2 , p values and pooled results through forest plots. Cohen d is calculated as the mean difference between the experimental and control group divided by the standard deviation of the learning outcome across both groups (Sedgwick & Marston, 2013).

The statistics I^2 , calculated as the percentage of total variation of all included studies, was used to measure the heterogeneity of effect sizes. The heterogeneity is considered commonly existent in different studies. Thus, we measure it through Higgins & Green's criteria (2011), i.e. the heterogeneity will be considered unimportant if $0\% < I^2 < 40\%$, moderate if $30\% < I^2 < 60\%$, substantial if $50\% < I^2 < 90\%$, and considerable if $75\% < I^2 < 100\%$. If I^2 is larger than 50%, the results will prove significantly heterogeneous. We will then adopt a random-effect model to conduct the meta-analysis. If I^2 is smaller than 50%, the results will prove insignificantly heterogeneous. We will thus conduct the meta-analysis using a fixed-effect model.

Z statistics will be adopted to test the publication bias. The p value being smaller than .05 indicates the presence of the publication bias while its being larger than .05 indicates the absence of the publication bias. We also tested the publication bias via Begg's and Egger's tests through funnel plots where no-effect lines and individual studies are shown, as well as specific effect sizes, and standard errors of effect sizes. The symmetric distribution of dots along the no-effect line in a funnel plot indicates the absence of the publication bias while the asymmetric distribution indicates the presence of the publication bias.

Results

Study selection

According to PRISMA flowchart (Moher et al., 2009), we obtained totally 12873 results from a number of databases, i.e. Taylor & Francis, Sage Publications, Springer Nature, Wiley, Elsevier, JSTOR, Web of Science, Science Direct, EBSCO, and Educational Research Complete. We obtained 1571 results after removing 11302 duplicated results via Endnote. Two reviewers selected 1189 results after independently screening and excluding 382 results after perusing abstracts, titles, and keywords. A total of 102 results passed the evaluation process. After removing 82 results due to various reasons such as incomplete data, improper design, and missing information, we selected 20 full texts. We then undertook the meta-analysis based on the included 20 studies, whose major characteristics are summarized in Table 1.

Characteristics of studies

As shown in Table 1, we summarize the main characteristics of included studies. The studies were conducted in various countries across the world, e.g. China, the USA, Austria, the Netherlands, Jordan, Chile, Spain, Malaysia, Indonesia, the UK, and India. The e-learning modes include a single e-learning course, multiple e-learning courses, inter-disciplinary e-learning courses, and various e-learning platforms. The educational levels of participants include university, elementary and secondary schools, and community college. The data collection methods include survey, pre- and post-tests, a written final assessment test, e-learning platforms such as e-HO, Moodle, and online English tests. The e-learning outcomes are classified into satisfaction, attitude, motivation, self-efficacy, and performance. The included studies can be classified into peer-reviewed journal articles, conference articles, and book chapters.

Table 1. Characteristics of included studies

N	Author/year	Outcome	Data collection	Country	participant
1	Albert & Johnson, 2011	Satisfaction	Survey	USA	University students
2	Altawallbeh et al., 2015	Attitude	Survey	Jordan	University students
3	Baylor & Kim, 2004	Self-efficacy	Test	USA	University students
4	Chu, 2010	Self-efficacy	Survey	China	Community college and senior learning center staff
5	Cuadrado-García, 2010	Satisfaction	Moodle platform	mixed	University students
6	González-Gómez, 2012	Satisfaction	Moodle platform	mixed	University students
7	Harb, Bakar, & Krish, 2014	Self-efficacy	Test	Jordan	University students
8	Harreiter et al., 2011	Attitude	Survey	Austria	University students
9	Hoogerheide et al., 2016	Satisfaction	Test	The Netherlands	Secondary school students
10	Hu & Hui, 2011	Self-efficacy	Test	China	University students
11	Lee et al., 2011	Attitude	e-HO platform	China	University students
12	Marimuthu et al., 2013	Performance	Survey	Malaysia	University students
13	Ong, & Lai, 2006	Self-efficacy	Survey	China	Company staff
14	Ramírez-Correa et al., 2015	Performance	Survey	Chile/Spain	University students
15	So & Swatman, 2010	Satisfaction	Survey	China	Primary and secondary school in-service teachers
16	Thayalan, 2012	Motivation	Survey	Indonesia	University students
17	Tung & Deng, 2007	Motivation	Survey	China	Elementary school students
18	Vate-U-Lan, 2019	Satisfaction	Survey	Mixed	University/secondary students
19	Verma & Dahiya, 2016	Attitude	Survey	India	University students
20	Zhu et al., 2009	Satisfaction	Test	China	University students

Tests of publication bias

To enhance the reliability of the results, we tested the publication bias using both Begg's and Egger's tests. As for Begg's test, we tested the publication bias using "metabias _ES _seES, begg" as a command to test the rank correlation between standardized intervention effect and its standard error (data input format theta se_theta assumed). The results indicate absence of publication bias (Kendall's Score (P-Q) = 144, Std. Dev. of Score = 227.36, $z = 0.63$, $Pr > |z| = 0.529$).

As for Egger's test, we entered the command "metabias _ES _seES, egger graph" into Stata MP/14.0 for detection of the publication bias since Egger's test can detect publication bias more sensitively than Begg's test (Egger et al., 1997). It is shown in Figure 2 that the studies are nearly symmetrically distributed along both sides of the regression line. We therefore conclude that the results indicate the absence of publication bias ($t = -0.64$, $p = 0.523$, 95% confidence interval = $-3.49 \sim 1.79$).

A sensitivity analysis

The sensitivity analysis is used to test the reliability or robustness of the meta-analysis via a leave-one-out method. If the leave-one-out method produces consistent results, then the meta-analysis will be

considered robust or reliable. To conduct the sensitivity analysis, we entered “numbers of participants, means, and standard deviations” across both experimental and control groups for the meta-based influence analysis. As shown in Figure 3, the meta-analysis estimates are all positioned between the upper and lower bounds of the 95% confidence interval given a named study is omitted. We, therefore, conclude that the meta-analysis results are robust or reliable.

Gender differences in e-learners’ self-efficacy in different countries

To determine whether a random-effect or fixed-effect model is used to run the meta-analysis of gender differences in e-learners’ self-efficacy in different countries, we firstly tested the heterogeneity of the meta-analysis estimates via a forest plot through Stata/MP 14.0 (Figure 4).

As shown in Figure 4, we obtained a total of 8 effect sizes to determine gender differences in e-learners’ self-efficacy in different countries such as the USA, China, Jordan, and the Netherlands. Since the overall results are significantly heterogeneous ($I^2 = 70.3$, $p = 0.001$), we adopted a random-effect model to conduct the meta-analysis. The diamond indicates the pooled effect of e-learners’ self-efficacy between males and females in different countries. In the USA, females present significantly higher self-efficacy than males ($d = -0.30$, 95% CI = $-0.55 \sim -0.06$, $z = 2.46$, $p = 0.014$) since the diamond is located to the left of the no-effect line. However, no significant gender differences in e-learners’ self-efficacy are shown in China ($d = 0.18$, 95% CI = $-0.10 \sim 0.46$, $z = 1.23$, $p = 0.219$), Jordan ($d = -0.06$, 95% CI = $-0.49 \sim 0.37$, $z = 0.28$, $p = 0.778$), the Netherlands ($d = 0.13$, 95% CI = $-0.16 \sim 0.43$, $z = 0.88$, $p = 0.379$), and overall results ($d = 0.07$, 95% CI = $-0.13 \sim 0.27$, $z = 0.71$, $p = 0.478$) since the diamonds all cross the no-effect line.

Gender differences in e-learners’ satisfaction in different countries

To summarize gender differences in e-learners’ satisfaction in different countries, we drew a forest plot using Stata/MP 14.0 (Figure 5).

We obtained a total of 23 effect sizes to determine gender differences in e-learners’ satisfaction in different countries. We adopted a random-effect model to conduct the meta-analysis since the overall estimates are significantly heterogeneous ($I^2 = 57.9\%$, $p < .01$). No significant gender differences in e-learners’ satisfaction are revealed in China ($d = 0.04$, 95% CI = $-0.34 \sim 0.42$, $z = 0.20$, $p = 0.842$), the USA ($d = -0.03$, 95% CI = $-0.38 \sim 0.32$, $z = 0.15$, $p = 0.882$), mixed countries ($d = 0.06$, 95% CI = $-0.10 \sim 0.21$, $z = 0.70$, $p = 0.484$), the Netherlands ($d = 0.04$, 95% CI = $-0.30 \sim 0.37$, $z = 0.21$, $p = 0.832$), and overall results ($d = 0.05$, 95% CI = $-0.07 \sim 0.18$, $z = 0.81$, $p = 0.421$) since all of their diamonds cross the no-effect line.

Gender differences in e-learners’ motivation in different countries

To examine the pooled effect of gender differences in e-learners’ motivation in different countries, we drew a forest plot using Stata/MP 14.0 (Figure 6).

We obtained a total of 12 effect sizes to examine e-learners’ motivation in different countries. Since the overall results are significantly heterogeneous ($I^2 = 52.0\%$, $p = 0.018$), we adopted a random-effect model to conduct the meta-analysis. No significant gender differences are found in e-learners’ motivation in mixed countries ($d = 0.07$, 95% CI = $-0.21 \sim 0.35$, $z = 0.46$, $p = 0.645$), China ($d = 0.15$, 95% CI = $-0.46 \sim 0.76$, $z = 0.49$, $p = 0.623$), Malaysia ($d = -0.20$, 95% CI = $-0.59 \sim 0.18$, $z = 1.02$, $p = 0.306$), Indonesia ($d = 0.17$, 95% CI = $-0.38 \sim 0.73$, $z = 0.61$, $p = 0.540$), and overall results ($d = 0.07$, 95% CI = $-0.14 \sim 0.27$, $z = 0.63$, $p = 0.527$) since all of their diamonds cross the no-effect middle line.

Gender differences in e-learners’ attitude in different countries

To examine gender differences in e-learners' attitude in different countries, we drew a forest plot using Stata MP 14.0 (Figure 7).

We obtained a total of 20 effect sizes to summarize the gender differences in e-learners' attitude in different countries. A random-effect model was adopted to run the meta-analysis since the overall results are significantly heterogeneous ($I^2 = 99\%$, $p < .01$). No significant gender differences in e-learners' attitudes are found in the USA ($d = -0.29$, 95% CI = $-0.90 \sim 0.32$, $z = 0.94$, $p = 0.346$), Jordan ($d = -0.07$, 95% CI = $-0.35 \sim 0.22$, $z = 0.45$, $p = 0.65$), and China ($d = 0.09$, 95% CI = $-0.08 \sim 0.26$, $z = 1.05$, $p = 0.292$) since their diamonds all cross the no-effect middle line. However, females' attitudes are significantly higher than males' in Austria ($d = -7.30$, 95% CI = $-9.40 \sim -5.21$, $z = 6.83$, $p < .01$), India ($d = -0.14$, 95% CI = $-0.23 \sim -0.05$, $z = 2.92$, $p = 0.004$), mixed countries ($d = -0.17$, 95% CI = $-0.25 \sim -0.09$, $z = 3.94$, $p < .01$), and overall results ($d = -0.74$, 95% CI = $-1.22 \sim -0.26$, $z = 3.04$, $p = 0.002$) since all of their diamonds are located to the left of the no-effect middle line.

Gender differences in e-learners' performance in different countries

We obtained a total of 14 effect sizes to determine gender differences in e-learners' performance in different countries (Figure 8).

We adopted a fixed-effect model to conduct the meta-analysis since the overall results are not significantly heterogeneous ($I^2 = 24.4\%$, $p = 0.19$). No significant gender differences in e-learners' performance are revealed in the USA ($d = -0.56$, 95% CI = $-1.18 \sim 0.06$, $z = 1.78$, $p = 0.075$), Jordan ($d = -0.05$, 95% CI = $-0.48 \sim 0.38$, $z = 0.23$, $p = 0.822$), the Netherlands ($d = 0.12$, 95% CI = $-0.09 \sim 0.34$, $z = 1.13$, $p = 0.259$), China ($d = -0.08$, 95% CI = $-0.27 \sim 0.12$, $z = 0.78$, $p = 0.435$), and Malaysia ($d = -0.21$, 95% CI = $-0.48 \sim 0.06$, $z = 1.51$, $p = 0.131$) since their diamonds all cross the no-effect middle line. However, female performance is significantly higher than male in mixed countries ($d = -0.22$, 95% CI = $-0.41 \sim -0.03$, $z = 2.27$, $p = 0.023$), and overall results ($d = -0.10$, 95% CI = $-0.20 \sim 0.00$, $z = 2.00$, $p = 0.046$) since their diamonds are located to the left of the no-effect middle line.

Discussion

Findings of this study are generally consistent with previous research. As for e-learners' self-efficacy, no significant gender differences have been revealed in all of the countries except the USA. Baylor & Kim's study (2004), conducted in the USA, concluded that females had significantly higher self-efficacy than males in the e-learning context. Female agents (around 61%) greatly outnumbered males (around 39%), which might have caused gender bias. The agents, merely representing gender-specific features, might have led to results different from the real humans participants although agents did play an important role in e-learning experiments. Participants working with female agents might have been positively influenced by their soft, encouraging voice and image, followed by enhanced self-efficacy.

We did not find any significant gender difference in e-learners' satisfaction in different countries. E-learning, as an innovative learning method, has drawn many learners' attention whether they are biologically male or female. It could bring great convenience to them through the advanced information technologies. Learners do not need to carry any heavy learning materials with them and they can engage in learning wherever and whenever they want to. Through e-learning platforms, they can swiftly transfer a huge amount of data and easily have access to learning resources. They can also enhance their

satisfaction with e-learning through frequent interactions with peers or teachers to solve difficult problems and arrange their learning activities. Teachers can gather enough data regarding students' feedback and decide teaching progress accordingly. This can improve both teachers' and students' satisfaction with the information technology assisted pedagogical approach.

No significant gender differences in motivation were revealed among e-learning participants. In the e-learning environment, learners can manage their learning activities on their own. E-learning activities are no longer limited by the physical classroom and the face-to-face teacher. They can establish learning goals, select learning contents, and determine learning styles based on their own preferences. E-learning provides unprecedented learning resources and creates an innovative learning environment, where learners tend to be greatly motivated to join the learning activities since they can conveniently learn via various kinds of apps, texts, videos, audios, and technologies. The e-learning environment also bridges the gap of communication through online collaborations. Learners can seek help from peers and resort to teachers for enquiry of difficult questions at will. They can also determine the learning progress and styles based on their own preferences, rather than limited to a certain style or progress. In this way, their learning motivation is improved whether they are female or male.

In the USA, Jordan, and China, there are no significant gender differences in the attitudes towards e-learning. Since both genders hold positive attitudes toward e-learning, designers and teachers may not need to cater the e-learning approach to a specific gender but to other demographics such as economic status (Albert & Johnson, 2011). When designing the e-learning strategy, teachers can comprehensively consider age and experience of Internet use to popularize and improve the effectiveness of use of e-learning approaches (Altawallbeh, Thiam, Alshourah, & Fong, 2015). Although no significant gender differences in attitudes were found toward e-learning, both genders hold lower levels of communication self-efficacy (Chu & Tsai, 2009). Communication skills, different from simple clicking, surfing or glimpsing, may need complicated cognitive involvements such as coordination of finger and eye movements and mental processing (Chu, 2010).

However, in Austria, India, and mixed countries (Chile and Spain), females hold significantly more positive attitudes towards e-learning than males. Females may join or initiate more communications with peers and teachers, hold more social presence, and thus feel more satisfied with e-learning activities, followed by more positive attitudes than males who tend to seek information rather than communication using the Internet (Gonzalez-Gomez, Guardiola, Martín Rodríguez, & Montero Alonso, 2012; Johnson, 2011). Males, mostly aiming at personal success and higher social status, tend to be isolated from their peers and involve into critical thinking although psychological researchers have proved no gender differences in their mental inborn feedback to surroundings (Salomone, 2007). The e-learning platform could provide learners with a large number of resources and opportunities, where females show significantly more intense interest in gender issues which tends to be criticized by males (Harreiter, Wiener, Plass, & Kautzky-Willer, 2011). Females may spend more time examining contents through the e-learning approach, leading to more positive attitudes than their male counterparts.

In general, females more positively evaluated e-learning than males since the pooled diamond is situated to the left of the no-effect line (Figure 7). Submerged in abundant information in the e-learning platform, females can be more interested in their favorite issues such as gender-related learning materials while males aim to seek information beneficial to their purpose. Females may concentrate more on the interesting issues than males who aim to seek information that can improve their social status. Concerning learning issues, females may show more interest than males since the former tends to aim at gender-based learning issues and acquire knowledge through communication and social presence while the latter aims at social rank issues (Harreiter, Wiener, Plass, & Kautzky-Willer, 2011). Males tend to be distracted by a sea of information in case they cannot find the information they need. In the e-learning context, males are more likely to present personal information representing their social status, while females are more likely to enjoy the benefits of social networking when social information is reduced. Females pay more attention to learning and social process and less attention to members of a learning community than males (Flanagin, Tiyaamornwong, O'Connor, & Seibold, 2002). This may enhance female attitudes towards e-learning and reduce male positive evaluation of an e-learning method.

Significant gender differences in e-learning performance were found among students at the London School of Economics (the UK) and University of Valencia (Spain) (Cuadrado-García, Ruiz-Molina, & Montoro-Pons, 2010). Females significantly outperformed males. As the authors mentioned, females greatly outnumbered males, which may have caused bias of results. We failed to reveal any gender difference in e-learners' performance in other countries such as the USA, the Netherlands, Jordan, Malaysia, and China. The new decade has been witnessing dramatic development of information technologies. Both males and females nowadays have equally convenient access to e-learning approaches in most of the countries across the world. Both genders tend to perform similarly but in the e-learning process, males pay more attention to the competitiveness in the course, while females regard the virtual classroom as an opportunity for online cooperative learning and cherish the cooperative e-learning environment (Arbaugh, 2002). Different preferences may have offset their different performance levels and cause insignificant gender differences in e-learning performance.

The e-learning environment can greatly facilitate discussion and opinion sharing, which can promote efficient information exchange and cultivate social relations between males and females (Wang, Christina, & Zhao, 2007). Social constructivists (e.g. Derry, Gance, Gance & Schlager, 2000) argued that discussion and opinion sharing could help learners construct high-quality knowledge structures. Through an appropriate teaching design, teachers can encourage students to solve difficult problems and facilitate active debates by gathering them online. Through frequent interactions and intentional organization of the teacher, balanced numbers of males and females can form an effective learning community under the supervision and guidance of the teacher, where both males and females can mutually assist for knowledge acquisition. Discussion and opinion sharing can bridge the gap of communication between males and females. They can increase their knowledge and improve their social skills, conducive to favorable e-learning performance. Different characteristics of both genders may have offset the originally different performance levels through the interactive process in the e-learning process.

Conclusion

Major findings

This study, including 20 high-quality publications, meta-analytically examined gender differences in e-learning outcomes, e.g. e-learners' self-efficacy, satisfaction, motivation, attitude, and performance across the world. Generally, there are no significant gender differences in e-learning learning outcomes.

Exceptions are that females significantly outperformed males in Spain and the UK, that in Austria, India, and mixed countries (Chile and Spain), females hold significantly more positive attitudes towards e-learning than males, and that in the USA, females present significantly higher self-efficacy than males.

Limitations

While this study is rigidly designed and follows the PRISMA flow process, there are still a number of limitations. Firstly, this study merely includes publications written in English, which may have caused publication bias. Secondly, this study cannot reach all of the literature due to the limitation of the library resource. Thirdly, the included studies may have biases themselves, which may have caused bias of results.

Future research directions

Gender in e-learning is a hot issue in need of interdisciplinary research such as psychology, sociology, linguistics, education, and computation. Future research into the gender issue may adopt cross-disciplinary research methods except for a meta-analysis.

References

Albert, L. J., & Johnson, C. S. (2011). Socioeconomic status-and gender-based differences in students' perceptions of e-learning systems. *Decision Sciences Journal of Innovative Education*, *9*(3), 421-436. <https://doi.org/10.1111/j.1540-4609.2011.00320.x>

Altawallbeh, M., Thiam, W., Alshourah, S., & Fong, S.F. (2015). Do the instructors differ in their behavioral intention to adopt e-learning based on age, gender, and Internet Experience? *Journal of Education and Practice*, *6*(18), 41-51.

Arbaugh, J. B. (2002). Managing the on-line classroom: a study of technological and behavioral characteristics of web-based MBA courses. *Journal of High Technology Management Research*, *13*(2), 203-223. [https://doi.org/10.1016/S1047-8310\(02\)00049-4](https://doi.org/10.1016/S1047-8310(02)00049-4)

Aydin, S. (2011). Internet anxiety among foreign language learners. *TechTrends: Linking Research & Practice to Improve Learning*, *55*(2), 46-54. <https://doi.org/10.1007/s11528-011-0483-y>

Baylor, A.L., & Kim, Y. (2004). Pedagogical Agent Design: The Impact of Agent Realism, Gender, Ethnicity, and Instructional Role. In: Lester, J.C., Vicari, R.M., & Paraguaçu, F. (eds) *Intelligent Tutoring Systems*. ITS 2004. Lecture Notes in Computer Science, vol 3220. Springer, Berlin, Heidelberg.
https://doi.org/10.1007/978-3-540-30139-4_56

Bimber, B. (2000). Measuring the gender gap on the Internet. *Social Science Quarterly*, 81, 868–876.

Chen, R. S., & Tsai, C. C. (2007). Gender differences in Taiwan university students' attitudes toward web-based learning. *CyberPsychology & Behavior*, 10(5), 645–654. <https://doi.org/10.1089/cpb.2007.9974>

Chu, R. J. (2010). How family support and Internet self-efficacy influence the effects of e-learning among higher aged adults-analyses of gender and age differences. *Computers & Education*, 55, 255–264.
<https://doi.org/10.1016/j.compedu.2010.01.011>

Chu, R. J., & Tsai, C. C. (2009). Self-directed learning readiness, internet self-efficacy, and preferences toward constructivist Internet-based learning environments among adult learners. *Journal of Computer Assisted Learning*, 25, 489-501. <https://doi.org/10.1111/j.1365-2729.2009.00324.x>

Cobb, S. C. (2009). Social presence and online learning: a current view from a research perspective. *Journal of Interactive Online Learning*, 8(3), 241-254.

Cuadrado-García, M., Ruiz-Molina, M. E., & Montoro-Pons, J. D. (2010). Are there gender differences in e-learning use and assessment? Evidence from an interuniversity online project in Europe. *Procedia-Social and Behavioral Sciences*, 2(2), 367–371. <https://doi.org/10.1016/j.sbspro.2010.03.027>

Danchak, M. M, Walther, J. B., & Swan, K. P. (2001, November). *Presence in mediated instruction: Bandwidth, behaviour, and expectancy violations*. A paper presented to the annual meeting on Asynchronous Learning Networks, Orlando, FL. November, 2001.

Derry, S. J., Gance, S., Gance, L. L., & Schlager, M. (2000). Toward assessment of knowledge building practices in technology - mediated work group interactions. In S. P. Lajoie (Ed.), *No more walls: Theory change, paradigm shifts and their Influence on the use of computers for instructional purposes* (Vol. II). Mahwah, NJ: Erlbaum.

Egger, M., Davey Smith, G., Schneider, M. & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *British Medical Journal*, 315(7109), 629-634. <https://doi.org/10.1136/bmj.315.7109.629>

Flanagin, A.J., Tiyaamornwong, V., O'Connor, J., & Seibold, D. R. (2002). Computer-mediated group work: The interaction of member sex and anonymity. *Communication Research*, 29, 66-93.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, 2(2-3), 87-105.
[https://doi.org/10.1016/s1096-7516\(00\)00016-6](https://doi.org/10.1016/s1096-7516(00)00016-6)

- González-Gómez, F., Guardiola, J., Martín Rodríguez, Ó., & Montero Alonso, M.Á. (2012). Gender differences in e-learning satisfaction. *Computers & Education, 58*, 283-290. <https://doi.org/10.1016/j.compedu.2011.08.017>.
- Hanauer, D., Dibble, E., Fortin, J., & Col, N. F. (2004). Internet use among community college students: implications in designing healthcare interventions. *Journal of American College Health, 52*, 197–202. <https://doi.org/10.3200/JACH.52.5.197-202>
- Harb, J., Bakar, N. A., & Krish, P. (2014). Gender differences in attitudes towards learning oral skills using technology. *Education & Information Technologies, 19*(4), 805-816. <https://doi.org/10.1007/s10639-013-9253-0>
- Harreiter, J., Wiener, H., Plass, H., & Kautzky-Willer, A. (2011). Perspectives on gender-specific medicine, course and learning style preferences in medical education: a study among students at the medical university of Vienna. *Wien Med Wochenschr, 161*(5-6), 149-154. <https://doi.org/10.1007/s10354-011-0866-x>
- Higgins, J.P.T., & Green, S. (2011). *Cochrane handbook for systematic reviews of interventions version 5.1.0* [updated March 2011]. The Cochrane Collaboration 2011. 2011 Available from www.handbook.cochrane.org.
- Hong, K. S. (2002). Relationships between students' and instructional variables with satisfaction and learning from a web-based course. *Internet and Higher Education, 5*, 267–281. [https://doi.org/10.1016/S1096-7516\(02\)00105-7](https://doi.org/10.1016/S1096-7516(02)00105-7)
- Hoogerheide, V., Loyens, S. M. M., & Van Gog, T. (2016). Learning from video modeling examples: does gender matter? *Instruction science, 44*, 69-86. <https://doi.org/10.1007/s11251-015-9360-y>
- Hsu, M. H., & Chiu, C. M. (2004). Internet self-efficacy and electronic service acceptance. *Decision Support Systems, 38*, 369–381. <https://doi.org/10.1016/j.dss.2003.08.001>
- Hu, J. H., & Hui, W. (2011). Is technology-mediated learning made equal for all? Examining the influences of gender and learning style. In T. Teo (ed.), *Technology Acceptance in Education: Research and Issues*, 101-122. Sense Publishers.
- Hung, M. L., Chou, C., Chen, C. H., & Own, Z. Y. (2010). Learner readiness for online learning: scale development and student perceptions. *Computers & Education, 55*(3), 1080-1090. <https://doi.org/10.1016/j.compedu.2010.05.004>
- Jackson, L. A., Ervin, K. S., Gardner, P. D., & Schmitt, N. (2001). Gender and the Internet: women communicating and men searching. *Sex Roles, 44*, 363–379. <https://doi.org/10.1023/A:1010937901821>
- Johnson, R. D. (2011). Gender differences in e-learning: communication, social presence, and learning outcomes. *Journal of Organizational and End User Computing (JOEUC), 23*(1), 79-94.

<https://doi.org/10.4018/joeuc.2011010105>

Keller, C., Hrastinski, S., & Carlsson, S. (2007). Students' acceptance of e-learning environments: A comparative study in Sweden and Lithuania. In Osterle, S. J., (Ed.), *Proceedings of the Fifteenth European Conference on Information Systems* (pp. 395-406). St. Gallen: University of St. Gallen.

<http://urn.kb.se/resolve?urn=urn:nbn:se:hj:diva-3099>

Lee, C. Y., Pan, P. J. D., & Liao, C. J. (2011). Impacts and preferences study for e-HO as a holistic learning environment complementary to e-learning. *Computers & Education*, *56*(3), 747-759.

<https://doi.org/10.1016/j.compedu.2010.10.017>

Lu, H., & Chiou, M. (2010). The impact of individual differences on e-learning system satisfaction: a contingency approach. *British Journal of Educational Technology*, *41*(2), 307–323.

<https://doi.org/10.1111/j.1467-8535.2009.00937.x>

Marimuthu, R., Chone, L. S., Heng, L. T., Nah, E. A., & Fen, O. S. (2013). Comparing the online learning strategies of male and female diploma students of an English language course. *Procedia - Social and Behavioral Sciences*, *90*(1), 626-633. <https://doi.org/10.1016/j.sbspro.2013.07.134>

Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G., & The PRISMA Group (2009) Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med*, *6*(7): e1000097.

<https://doi.org/10.1371/journal.pmed.1000097>

Moule, P. Pontin, D. Gilchrist. M. Ingram, R. (2003). *Critical appraisal framework*. Retrieved Feb. 8, 2021, <http://learntech.uwe.ac.uk/da/Default.aspx?pageid=1445>

Ong, C. S., & Lai, J. Y. (2006). Gender differences in perceptions and relationships among dominants of e-learning acceptance. *Computers in Human Behavior*, *22*(5), 816-829.

<https://doi.org/10.1016/j.chb.2004.03.006>

Papastergiou, M., & Solomonidou, C. (2005). Gender issues in Internet access and favourite Internet activities among Greek high school pupils inside and outside school. *Computers & Education*, *44*, 377–393. <https://doi.org/10.1016/j.compedu.2004.04.002>

Pituch, K. A., & Lee, Y. K. (2006). The influence of system characteristics on e-learning use. *Computers & Education*, *47*, 222–244. <https://doi.org/10.1016/j.compedu.2004.10.007>

Price, L. (2006). Gender differences and similarities in online courses: challenging stereotypical views of women. *Journal of Computer Assisted Learning*, *22*(5), 349-359. <https://doi.org/10.1111/j.1365-2729.2006.00181.x>

Ramírez-Correa, P.E., Arenas-Gaitán, J., & Rondán-Cataluña, F.J. (2015). Gender and Acceptance of E-Learning: A Multi-Group Analysis Based on a Structural Equation Model among College Students in Chile and Spain. *PLoS ONE* *10*(10): e0140460. <https://doi.org/10.1371/journal.pone.0140460>

- Reda, A., & Dennis, M. (1992). Cognitive style, gender, attitude toward computer-assisted learning and academic achievement. *Educational studies, 18*(2), 151-160.
<https://doi.org/10.1080/0305569920180202>
- Salomone, R. (2007). Igualdad, y diferencia. La cuestión de la equidad de género en la educación. *Revista española de Pedagogía, 65*(238), 433-446.
- Sedgwick, P., & Marston, L. (2013). Meta-analyses: standardised mean differences. *BMJ, 347*, f7257.
<https://doi.org/10.1136/bmj.f7257>
- Shashaani, L., & Khalili, A. (2001). Gender and computers: similarities and differences in Iranian college students' attitudes toward computers. *Computers & Education, 37*, 363–375.
[https://doi.org/10.1016/S0360-1315\(01\)00059-8](https://doi.org/10.1016/S0360-1315(01)00059-8)
- So, K.K.T., & Swatman, P. (2010). *The Diminishing Influence of Age and Gender on e-Learning Readiness of Teachers in Hong Kong*, in P. Tsang et al. (Eds.): ICHL 2010, LNCS 6248, pp. 477-488, 2010. Springer-Verlag Berlin Heidelberg.
- Thayalan, X., Shanthi, A., & Paridi, T. (2012). Gender difference in social presence experienced in e-learning activities. *Procedia - Social and Behavioral Sciences, 67*(1), 580-589.
<https://doi.org/10.1016/j.sbspro.2012.11.363>
- Thompson, L. F., Meriac, J. P., & Cope, J. G. (2002). Motivating online performance: The influences of goal setting and internet self-efficacy. *Social Science Computer Review, 20*(2), 149–159.
<https://doi.org/10.1177/089443930202000205>
- Torkzadeh, G., & Van Dyke, T. P. (2002). Effects of training on internet self-efficacy and computer user attitudes. *Computers in Human Behavior, 18*, 479–494. [https://doi.org/10.1016/S0747-5632\(02\)00010-9](https://doi.org/10.1016/S0747-5632(02)00010-9)
- Tung, F. W., & Deng, Y. S. (2007). Increasing social presence of social actors in e-learning environments: effects of dynamic and static emoticons on children. *Displays, 28*(4-5), 174-180.
<https://doi.org/10.1016/j.displa.2007.06.005>
- Vate-U-Lan, P. (2020). Psychological impact of e-learning on social network sites: online students' attitudes and their satisfaction with life. *Journal of Computing in Higher Education, 32*, 27–40.
<https://doi.org/10.1007/s12528-019-09222-1>
- Verma, C., & Dahiya, S. (2016). Gender difference towards information and communication technology awareness in Indian universities. *SpringerPlus, 5*(1), 370. <https://doi.org/10.1186/s40064-016-2003-1>
- Wang, M., Christina, S., & Zhao, X. (2007). Gender differences, dialogue style and equal participation in online learning. *China Distance Education, 2*, 25-29.

Whitely, B. E. Jr., (1997). Gender differences in computer related attitudes and behavior: A meta analysis. *Computers in Human Behavior*, 13(1), 1-22. [https://doi.org/10.1016/S0747-5632\(96\)00026-X](https://doi.org/10.1016/S0747-5632(96)00026-X)

Yukselturk, E., & Bulut, S. (2009). Gender differences in self-regulated online learning environment. *Educational Technology & Society*, 12(3), 12–22.

Zhu, C., Valcke, M., & Li, S. Y. (2009). Chinese students' perceptions of a collaborative e-learning environment and factors affecting their performance: implementing a flemish e-learning course in a Chinese educational context. *Asia Pacific Education Review*, 10, 225-235.
<https://doi.org/10.1007/s12564-009-9021-4>

Appendix

Appendix A. University of West England Framework for Critically Appraising Research Articles (Moule et al., 2003)

The Introduction

Is there a clear statement about the topic being investigated?

Is there a clear rationale for the research?

The Methods Section

Is the research design clearly described?

Are the research methods appropriate for the topic being investigated?

Are any advantages or disadvantages of the design acknowledged by the researchers?

Is there a clear statement about how the participants were selected?

Data Collection and Analysis. Is there a clear description about how the data was collected?

Was the data collected by appropriate people?

Is the approach to data analysis appropriate to the type of data collected?

Quantitative. Is there any explanation of sample size used?

Are the type of statistical tests used appropriate for the sorts of data collected?

Qualitative. Is the approach taken to data analysis clear?

Is there a clear statement about how the researcher validated interpretations?

Ethics

Is there a clear statement about ethical committee approval? Is there a clear description about gaining consent, maintaining anonymity and or confidentiality?

The Results/Findings

Are the results related back to the literature review?

Are the weaknesses in research design acknowledged?

Quantitative. Is the presentation of results clear and unambiguous? Are all the results presented?

Do the tables and charts used give a clear picture of the sample data and results?

If percentages are recorded, are actual numbers also clearly shown?

Are results of tests interpreted rightly?

Qualitative. Does the research present evidence of the data collected?

Does the data presented as part of a theme support the analysis suggested?

Is there a clear audit trail?

The Conclusions

Are the implications for further research acknowledged? Are areas for further research identified? Are further recommendations made for practice that come from the results/discussion?

Declarations

Compliance with Ethical Standards:

The study complies with Ethical Standards.

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Conflict of Interest: The authors declare that they have no conflict of interest.

Figures

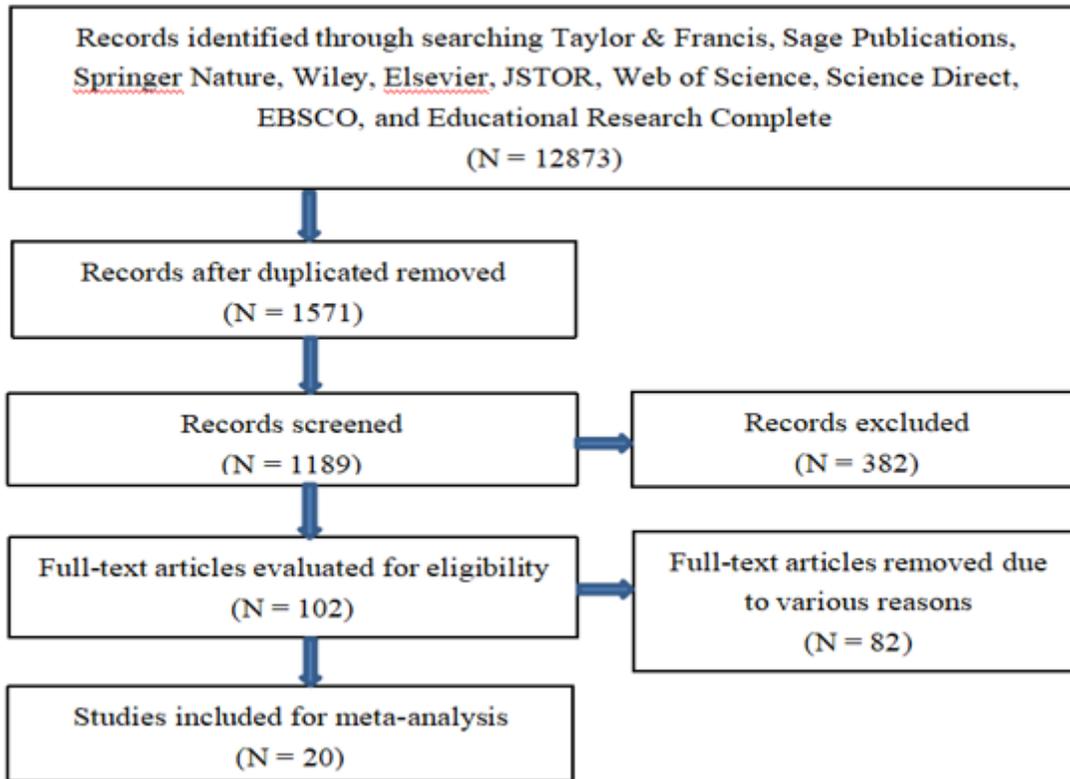


Figure 1

A flowchart of literature inclusion

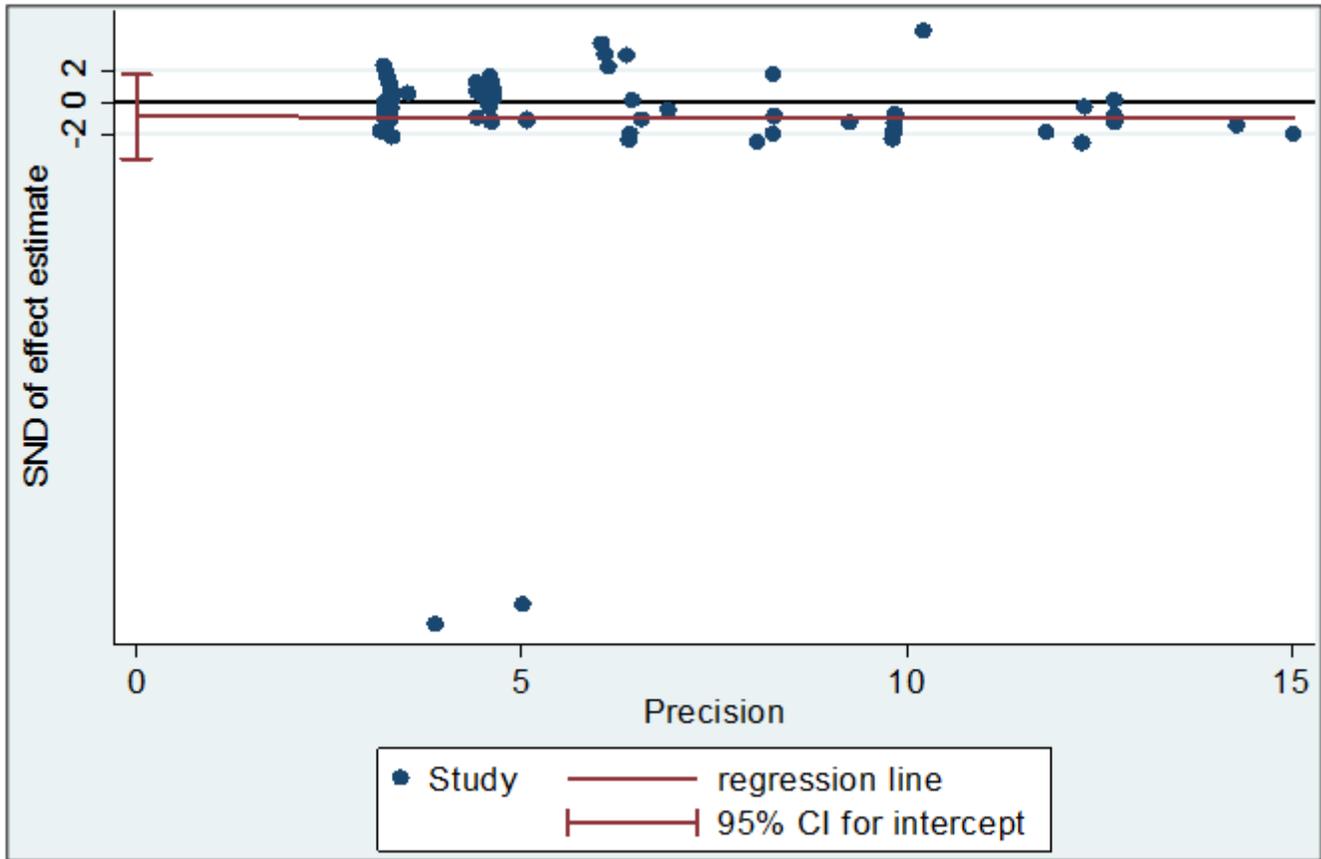


Figure 2

A plot of publication bias using Egger's test

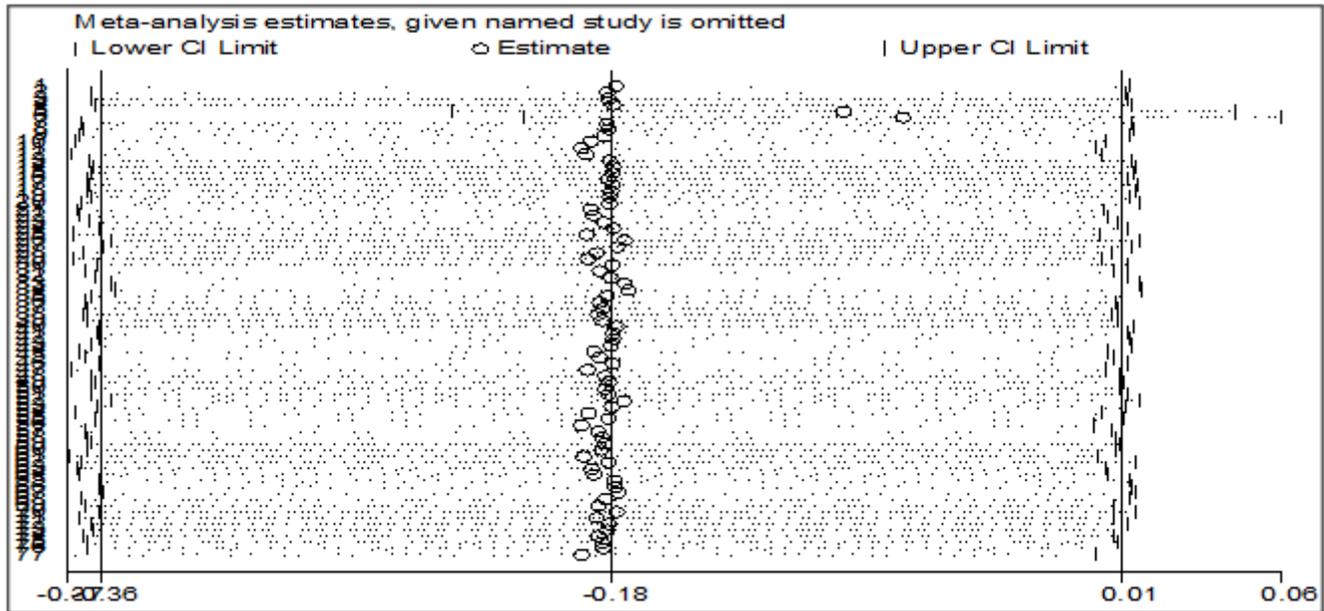


Figure 3

A plot of sensitivity analysis

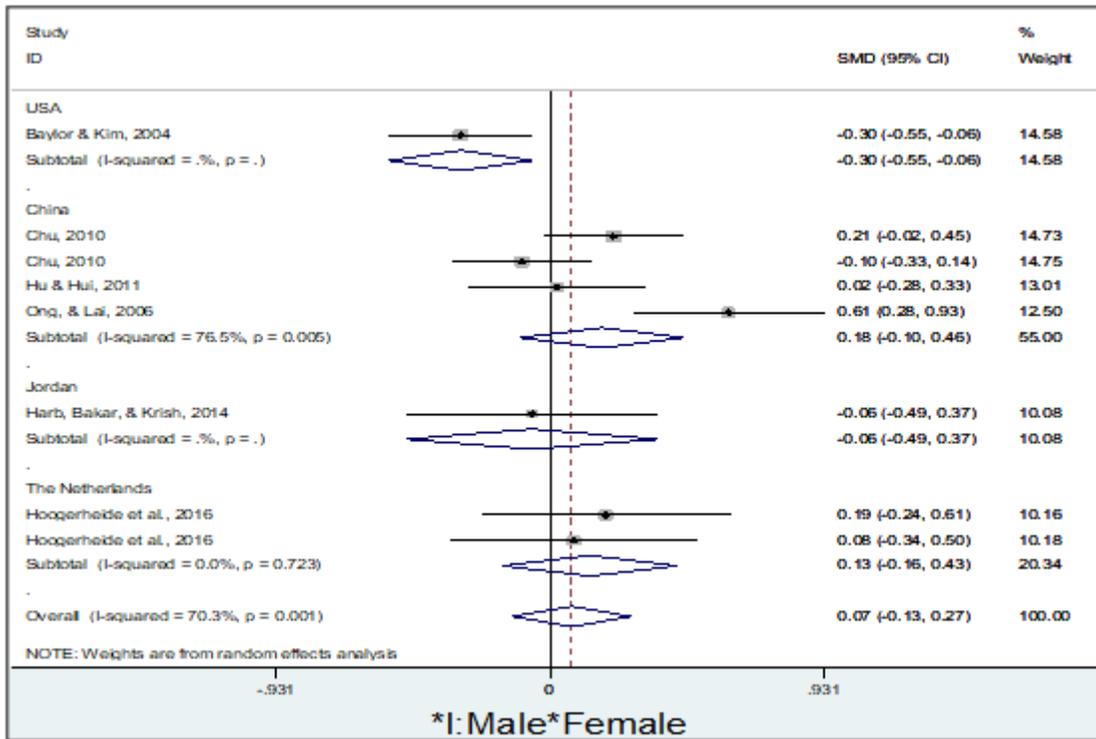


Figure 4

Gender differences in e-learners' self-efficacy in different countries

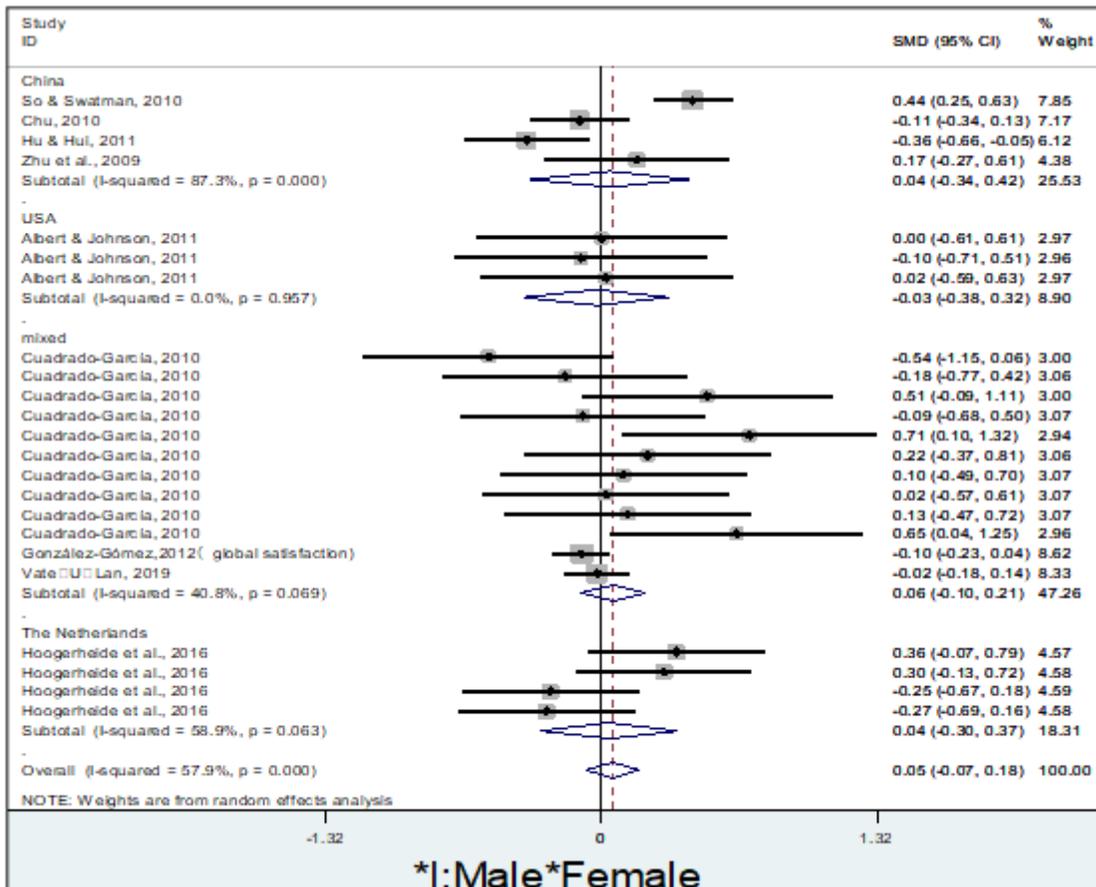


Figure 5

Gender differences in e-learners' satisfaction in different countries

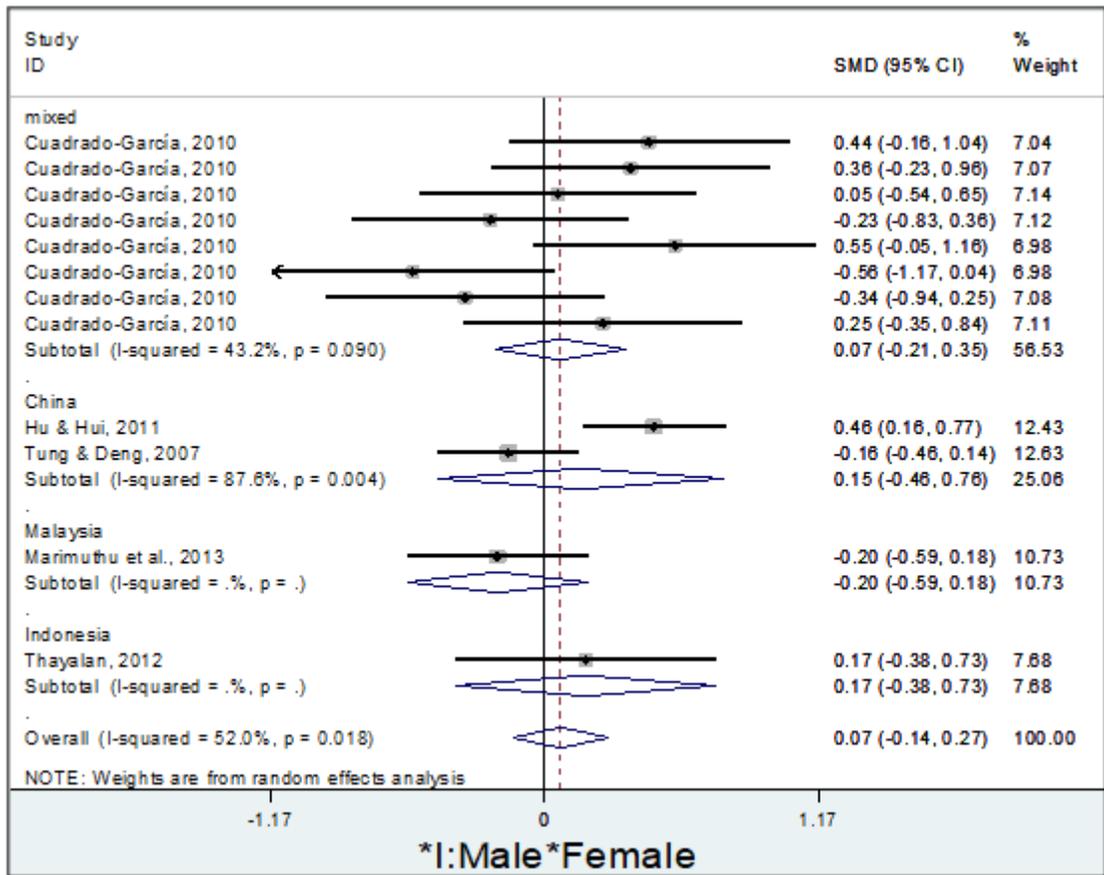


Figure 6

Gender differences in e-learners' motivation in different countries

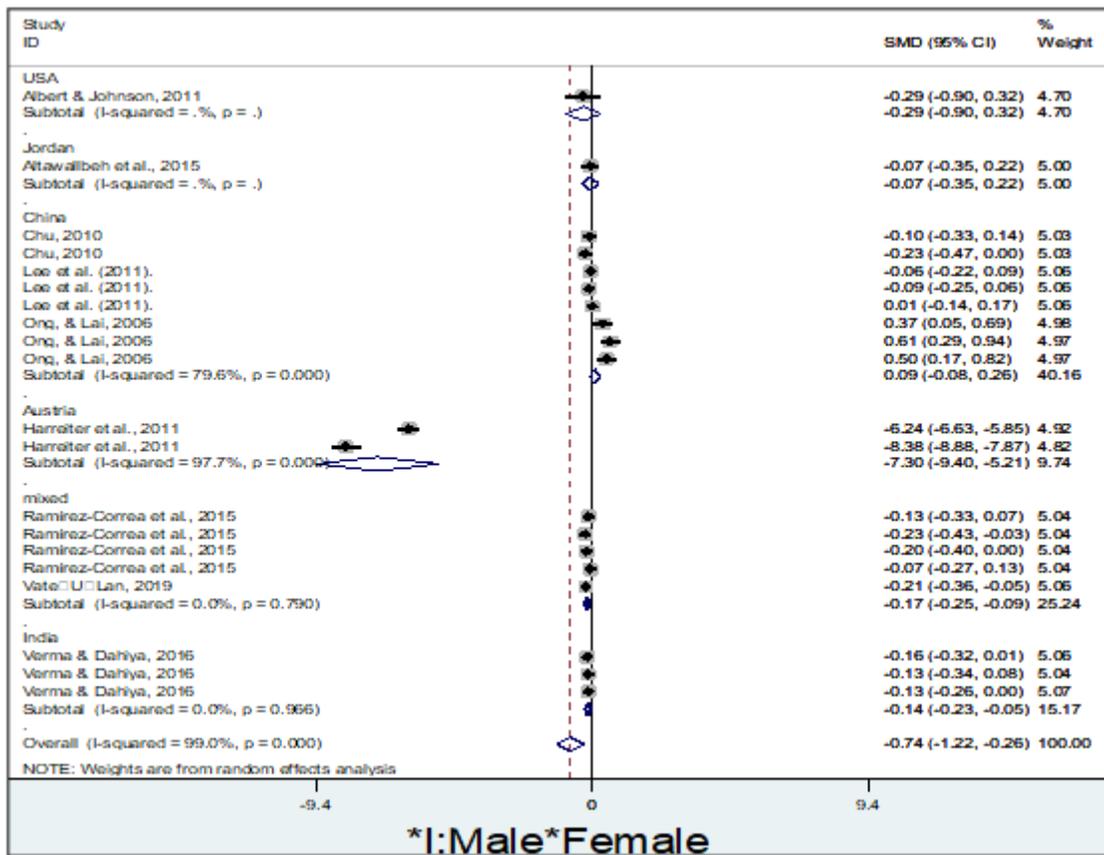


Figure 7

Gender differences in e-learners' attitude in different countries

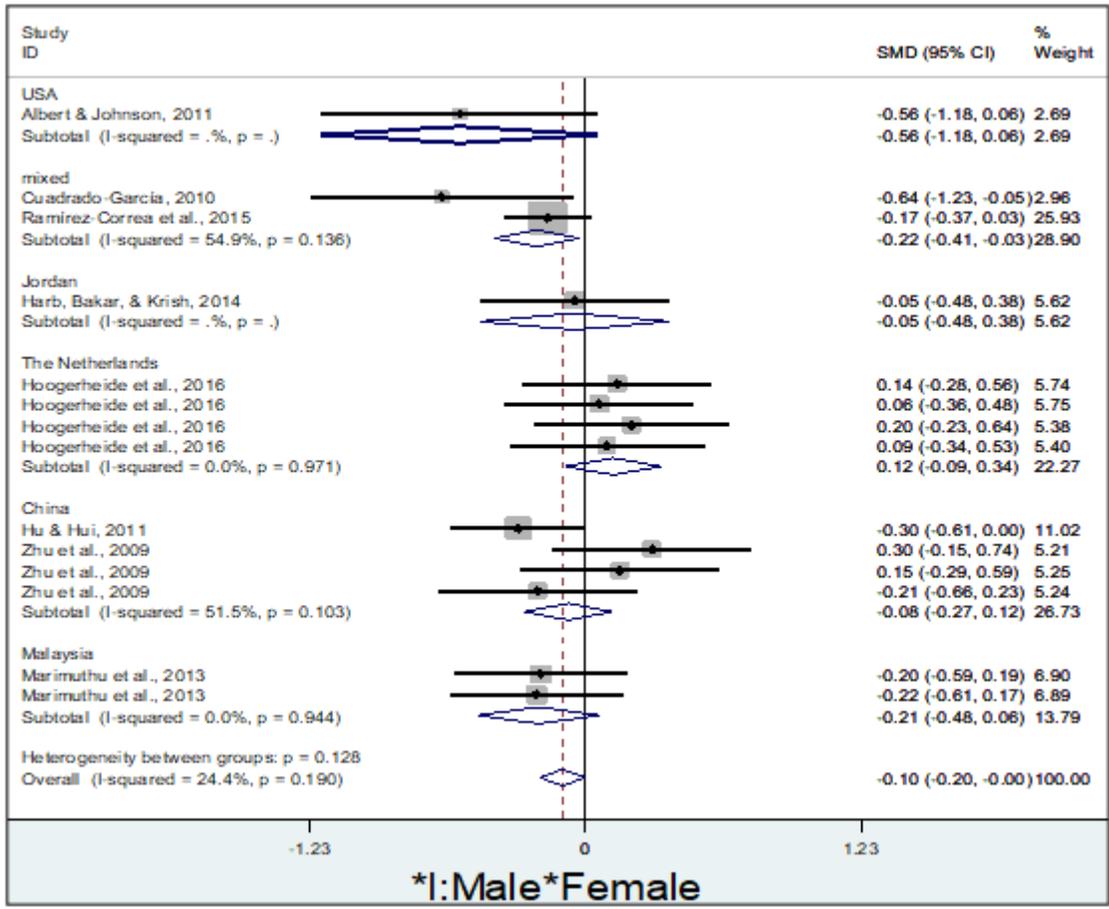


Figure 8

Gender differences in e-learners' performance in different countries

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [dataset26update.xlsx](#)