RedFame

Journal of Education and Training Studies
Vol. 4, No. 5; May 2016
ISSN 2324-805X E-ISSN 2324-8068
Published by Redfame Publishing
URL: http://jets.redfame.com

The Effects of Gender on the Attitudes towards the Computer Assisted Instruction: A Meta-analysis

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Received: April 2, 2016 Accepted: April 12, 2016 Online Published: April 26, 2016

doi:10.11114/jets.v4i5.1515 URL: http://dx.doi.org/10.11114/jets.v4i5.1515

Abstract

The idea that gender factor creates a difference on computer usage and computer-assisted instruction is based upon previous years. At that time, it was thought that some areas like engineering, science and mathematics were for males so it created a difference on the computer usage. Nevertheless, developing technology and females becoming more active in information era alter this imbalance. About analyzing this kind of studies, significant differences exist on behalf of males in some studies, while significant differences exist on behalf of females in some studies, and there is no significant difference in terms of genders in other studies. While gender variable has been dealt as sub-variable in studies conducted with teachers in terms of learning/teaching activities, the number of meta-analyses investigating related teaching method according to gender is limited. In this study, meta-analysis method which gathers the results of different studies on the same specific topic and analyzing these findings statistically, is used. Comprehensive Meta Analysis (CMA) Statistic Program was used for statistical analysis. The data was analyzed by using the method of study effect meta-analysis. Gender factor is a crucial variable for learning and teaching activities. However, with this research, it becomes obvious that it is not such an important factor that can create a huge difference. Publication type, sample type and geographical region are determined as moderator variables with the thought that they can create a difference. Any difference cannot be identified according to publication and sample type at the end of the research.

Keywords*:* meta-analysis, gender, computer-assisted instruction

1. Introduction

Computers, which are essential in the era of technology and leave their marks on the 21st century, are focused on educational areas as well as many other areas. Today, education utilizing computer assistance is improving and advancing. There are significant differences between the learning environments from the 1960's to 2010. The foremost of these differences is using technological devices in the classroom environment such as computers, smart boards, and tablets (Canbolat, 2011).

According to these developments, it can be said that computers have become smaller and more functional, especially in the last decade. Accordingly, their portability has improved resulting in an increase in frequency of occurrence in and out of the school (Shapka & Ferrari, 2003). The benefit of instruction using computer assistance is incontrovertible if the utilization of educational opportunities and keeping up with the times is desired. According to Robyler (2003), researchers have revealed some terms about the usage of computers pertaining to education and instruction. "Computer-Assisted Education" (CAE) and "Computer-Assisted Instruction" (CAI) terms are common in activities utilizing computers for learning and teaching.

In literature, these two terms are not synonymous. The difference results from the conclusions drawn between educational and instructional notions. Education, which is a more comprehensive term compared to instruction, comprises all curricular and extracurricular activities. In this manner, computer-assisted education and the whole process from teaching a lesson by using a computer to saving lecture notes on a computer are included in the education. Computer-assisted instruction refers to teaching a lesson based on mutual interaction by using a computer. It refers to the learning environment which covers only the relevant lesson (Jones, 1995; Kucuk et al, 2014; Teo et al., 2015). In other words, computer-assisted education is a broader term which includes computer-assisted instruction. It can be said that CAI and CAE can be replaced thanks to this inclusive feature.

The term computer-assisted education/instruction was introduced was introduced after the utilization of computers for teaching and learning. The combination of the visual, audial and interactive features of computers substantially increases their importance for education (Ornstein & Lasley, 2004).

Yalin (2003) defines computer-assisted instruction as the usage of computers for reinforcing the acquired behaviors and teaching lessons by programming computers according to the system. Roblyer (2003) defines CAI as a supporting device making teaching and understanding easier during the instruction period. In other words, computer-assisted instruction means that computers are used for making the learning process more effective in instruction. According to Sahin and Yildirim (1999), CAI is a teaching method where computers are used in a learning environment and learners can utilize them according to their learning rate. From gathering computer technologies and principles of self-learning CAI is a method which strengthens student motivation and the teaching process. According to Usun (2004), CAI is a teaching method that uses computers as a supportive element so that learning can take place and learners can utilize them according to their learning rate. Thus, forming from gathering computer technologies and principles of self-learning CAI is a method which strengthens student motivation and teaching process.

No matter how it is defined, in computer-assisted instruction, it is essential that computers must be a complementary and strengthening device instead of a substitute for teaching (Demirel, Seferoglu & Yagci, 2004). In short, teachers play a role in acquiring the defined goal and behaviors; computers play a role as supportive devices (Demirel, 2003; İsman, 2001; Ornstein & Lasley, 2004). In this regard, computers are indispensable for modern-day education.

In reference to the usage of computers as instructional devices, teachers' behaviors pertaining to this subject result in significant variables. Some features such as computer skills time spent on the computer, and the attitudes towards computers affect the usage of computer-assisted instruction (Vannata & Fordham, 2004). In developing information era, the features that all countries want to bring the teachers in are focused. In a global world, some skills like using computers as problem solving devices, utilizing them for active participation and intensifying teaching are expected from teachers (Teo et al., 2015). In that vein, while determining teaching proficiency, the Ministry of National Education states that teachers must have technology literacy skills (MEB, 2016). Some problems may arise in cases where instructors teach traditionally to students who use computers regularly in their daily life. In this regard, teachers' attitudes should be positive in order to be able to use computers in teaching/learning environments. Using computer-assisted instruction cannot be expected from a teacher who approaches computer assistance negatively and does not indigenize it (Pedraira & Pear, 2015).

Many variables can affect the attitudes of teachers towards computer-assisted instruction usage, such as age, branch, seniority and gender (Kocasarac, 2003; Topcu, 2009; Teo et al., 2015). Therefore, numerous studies have been conducted (Basarici & Ural, 2009; Andoh, 2012; Saricoban, 2013; Ates et al., 2016). Gender variable is remarkable because has been studied in most of the research. The idea that gender factor creates a difference on computer usage and computer-assisted instruction is based upon previous years. At that time, it was thought that some fields such as engineering, science and mathematics were for males and therefore created a difference on the computer usage (Ustundag, 2001). Thus, when the studies conducted before the 80's (Hess & Muira 1985) were analyzed, it was found that males had more positive attitudes towards technology (Topcu, 2009). Nevertheless, developing technology and female participation in the information era alter this imbalance. When analyzing these studies, significant differences exist on behalf of males in some studies (Cetin & Gungor, 2014), while significant differences exist on behalf of females in other studies (Kutluca & Ekici, 2010; Kaplan et al., 2013). Conversely, there is no significant difference in terms of genders in other studies (Shapka & Ferrari, 2003; Tuncer & Tanas, 2011; Saricoban, 2013; Cakmak & Taskiran, 2014; Kucuk et al., 2014; Teo et al., 2015; Ates et al., 2016).

While gender variable has been dealt with as a sub-variable in studies conducted with teachers in terms of learning/teaching activities, the number of meta-analyses investigating related teaching method according to gender is limited. One of them is the study conducted by Topcu (2009) investigating the effects of gender on computer attitudes. According to the findings of this study, there are a few differences according to Cohen's classification and there are nominal differences according to Thalheimer's classification in terms of gender. Additionally, Whittley (1997) investigates changes of attitudes and behaviors towards computer according to gender by conducting a meta-analysis. As a result, he reveals that gender in fact does not create any differences. Except from these above, there are no more comprehensive studies which investigate attitudes towards computer-assisted instruction in terms of gender at the national and international level. It is thought that this study will contribute the literature in this regard. Meta-analysis studies are needed for observing the big picture and obtaining more comprehensive results (Akgoz, Ercan & Kan, 2004). As stated above, in some studies where gender factor is investigated as a sub-variable, results are on behalf of males while in some of them the results are on behalf of females. However, the important thing is looking at the general effect of the studies conducted in this area as a whole. Meta-analysis was used for determining whether there is a gender effect on attitudes towards computer-assisted instruction in learning and teaching activities. It was used for directing ongoing studies in this area.

Meta-analysis studies, which assess several studies on a specific topic at the same time, are spreading like wildfire all around the world. Using meta-analysis is becoming more common in our country, especially in the medical and agricultural fields. However, in educational sciences these studies are less frequent (Kasarci, 2013 as cited in Sahin, 2005). Therefore, when looking at the studies on computer-assisted instruction, it can be observed that different variables have been applied and they are limited (the study on the effect of computer-assisted instruction about academic success (Camnalbur & Erdogan, 2008), the study on the effectiveness of foreign language lessons with computer-assisted instruction method (Tomakin & Yesilyurt, 2013), the study on the effect of computer-assisted mathematic instruction about academic success (Demir & Basol, 2014)). From this point of view, it is thought that this study will contribute to meta-analysis studies on education in our country.

According to Topcu (2009), in our country and the world there is an impression that the attitudes of males towards computer are more positive than the attitudes of females. This impression needs to be supported using numerical values. This study aims to gather the results of different studies on attitudes of teachers and pre-service teachers towards computer-assisted instruction and investigate the gender factor. These are the research questions:

1. What effect does gender have on the attitudes of teachers and pre-service teachers towards computer-assisted instruction?
2. Are there any significant differences between influence quantities according to participants (teachers and pre-service teachers) who are involved in the sample?
3. Are there any significant differences between influence quantities according to publication type?
4. Are there any significant differences between influence quantities according to geographical region that studies are conducted?

2. Method

In this study, the meta-analysis method which gathers the results of different studies on the same specific topic and analyzes these findings statistically, is used. The analysis is conducted for reaching a new and general result by combining statistical findings from independent studies (Dincer, 2014). In general terms, Figure 1 schematizes the process steps of a meta-analysis.

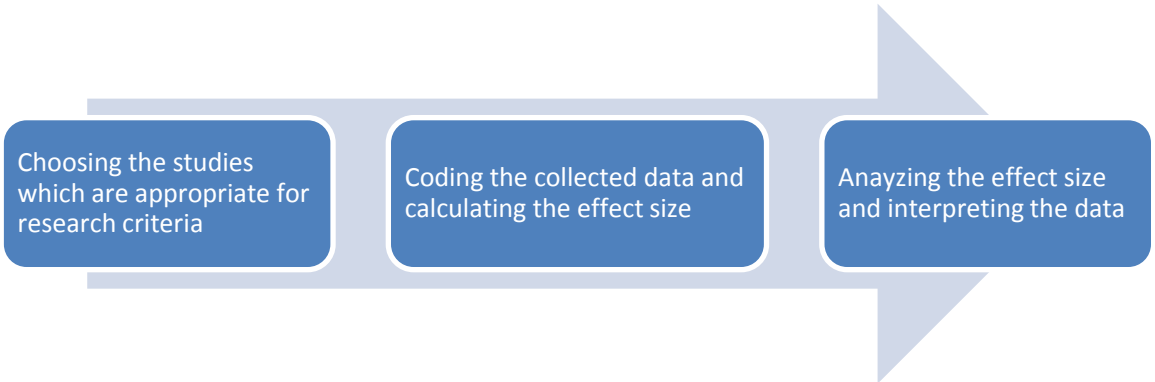


Figure 1. *Meta-analysis process steps are adopted from Hoffler and Leutner (2007).*

In these general terms, inclusion criteria, making a literature review and coding methods are mentioned below. After that, analysis of the data is explained.

2.1 Inclusion Criteria, Making a Literature Review and Coding Methods

Master thesis and PhD dissertations in Turkey were examined in order to determine the effect of gender on teachers' and pre-service teachers' attitudes towards computer-assisted instruction. In order to reach the related studies, "computer-assisted instruction", "attitude", "teacher" and "pre-service teacher" key words were used. The studies which are included into the research were reached by using Google Scholar search engine, Tubitak Ulakbim Dergi Park, and Council of Higher Education National Thesis Center data bases. While determining the sources which will be included, there were some requirements such as the sample being conducted in Turkey and conducted by Turkish researchers. The studies which are not open to public access or where the full version cannot be reached were not included into the research. It was crucial that the studies were empirical and male-female groups were independent variables in order to obtain the effect size. For male-female teacher groups; sample size, mean, standard deviation values were studied in order to calculate the effect size which is needed for meta-analysis study. After this elimination process, the research was conducted with 36 studies which include 19 articles, 16 master theses, and 1 PhD dissertation. During literature review, it was seen that the first study on this subject was in 2000 and the last study was in 2015. So the studies

(2000-2015) appropriate to the coding criteria were involved into the research.

2.2 Coding Period

First of all, each study was examined according to the study criteria from the beginning. After that, information which is suitable for coding protocol was designed for every study. In coding protocol, there are three parts; "study identity" showing study's name, year, authors and publication type, "study content" showing sample content and range of application, "study data" showing sample size, means, standard deviations.

2.3 Validity of the Research

Expert opinions were asked about the points to be considered on coding while the data was analyzed for persuasiveness of the research. The scanning process was repeated by researchers at different places and times. Findings confirmed each other. While coding, all summary information was written so that any mistakes could not happen and the researchers checked and confirmed by analyzing them separately.

2.4 Data Analysis

Comprehensive Meta Analysis (CMA) Statistic Program was used for statistical analysis. The data was analyzed by using the method of study effect meta-analysis. In this method, the aim is to calculate the differences between the mean of experiment and control groups (Borenstein, Hedges & Rothstein 2007). 0.05 was chosen as the significance level of statistical analysis. For determining the heterogeneity, which is the first step of data analysis, Chi-Square Test (Q statistics) with (q-1) degree of freedom was suggested by Cochran (1954). According to the results of the heterogeneity test, effect sizes are calculated by using fixed effect model or random effect model. If effect sizes show homogeneous distribution, fixed effect model is used. If effect sizes do not show homogeneous distribution, random effect model is used (Dincer, 2014).

Moderator variables were determined as sample type, geographical region and publication type in the research. According to teachers and pre-service teachers, a change deriving from teaching experiences can be seen. According to the geographical conditions, a change deriving from different opportunities of the learning/teaching process can be seen. Because time and the number of participants can affect the results, these three moderators and the scope of the study were considered.

Effect size classifications which are often used in literature were used in this research and are given below:

The classification belongs to Cohen (1988):

d=0,20 – 0,50 low level (small)

d=0,50 – 0,80 medium level (medium)

d=0,80< d high level (large)

More detailed classification compared to Cohen belongs to Thalheimer and Cook (2002):

- 0.15 < d < 0.15 non-significant level (negligible, trivial)

0.15 < d < 0.40 low level (small)

0.40 < d < 0.75 medium level (medium)

0.75 < d < 1.10 high level (large)

1.10 < d < 1.45 very high level (very large)

1.45 < d perfect level (huge)

3. Findings

3.1 Study Characteristics

In this research investigating the effect of gender on the attitudes towards computer-assisted instruction, general characteristics and effect sizes of studies were determined by using the number of samples, mean and standard deviation of 36 studies. The data was obtained from total 7326 participants 3297 males and 4029 females.

In the research, three moderators were focused on such as publication type, geographical region and sample type. Table 1 shows descriptive statistic belonging to these moderators.

Table 1. Descriptive Statistics about Studies Investigating the Effect of Gender on Attitudes towards Computer-Assisted Instruction

Variables	Levels	n
Publication Type	Article	19
	Master thesis	16
	PhD dissertation	1
Geographical Region	Central Anatolia	9
	Marmara	9
	Aegean	4
	Eastern Anatolia	6
	Southeastern Anatolia	1
	Mediterranean	3
	Black Sea	4
Sample Type	Teacher	16
	Pre-service Teachers	20

According to publication type; there are 19 articles, 16 master theses and 1 PhD dissertation. While analyzing the studies according to geographical region; there are 9 studies in Central Anatolia, 9 studies in Marmara, 6 studies in Eastern Anatolia, 4 studies in Black Sea, 4 studies in Aegean, 3 studies in Mediterranean and 1 study in Southeastern Anatolia. These studies are close to each other in terms of the sample type distribution. There are 16 teachers and 20 pre-service teachers in the study.

3.2 Findings about Whether Gender Creates a Difference on Attitude towards Computer-assisted Instruction or Not

In meta-analysis studies, effect sizes can be determined by using various methods. Random effect methods and fixed effect methods can be used for calculating the effect size. The selection of the method depends on the accepted hypothesis. The choice of random or fixed effect method is about the homogeneous or heterogeneous distribution assumptions of studies. Thus, heterogeneity test must be done before the calculation of effect size. According to heterogeneity testing; Q statistic is calculated and p value which is significance level of Q statistic is interpreted. If p is significant, there is significant difference between studies resulting in heterogeneity. In this situation, using fixed effect model is not appropriate. Random effect model gives truer effect size value in case of heterogeneity. If p is not significant, there is no significant difference between studies making the results homogeneous. In this situation, using fixed effect model is more preferable (Akgoz et al., 2004, Dincer, 2014).

In this regard, first of all, heterogeneity test was analyzed. According to heterogeneity test result ($Q_{(34)}$=112,642, p<.05); the studies are heterogeneous among them. The level of heterogeneity was determined as %70 (I^2=%69,816). Random effect model was used because the studies are heterogeneous.

Studies included in the research were analyzed one by one before determining mean effect size. Meta-analysis diagram (forest plot) was formed for analyzing the unified effect size of the studies (Figure 1). In this diagram, effect sizes and confidence intervals can be seen separately. Under the graphic, mean effect size according to random effect model can be seen. There are positive (+) and negative (-) studies according to effect size when they are analyzed one by one. Based on this finding, there are studies stating that females were more positive towards computer-assisted instruction and vice versa. In the research, male is chosen as the reference group. The studies with positive (+) effect sizes are on behalf of males while the studies with negative (-) effects sizes are on behalf of females. The size and thickness of plus mark show the wideness of confidence interval. The longer horizontal line of plus mark is, the wider confidence interval of the study is (Borenstein, Hedges & Rothstein 2007; Dincer, 2014).

According to the diagram shown in Figure 2; widest confidence interval belongs to Yilmaz and Alici (2011) and Telli (2009), lowest confidence interval belongs to Cobanoglu (2005). When the studies are analyzed one by one, it can be seen that 17 studies are negative and 19 studies are positive. However, total effect size of the research is on the positive side. According to this as shown in Table 2, the studies found that positive attitudes on behalf of males are more although mean effect size is not significant (Gozuyesil & Dikici, 2014 as cited in Wolf, 1986).

Table 2. Findings about meta-analysis effect size according to random effect model

Effect Size (ES)	Z	p	Q	I^2	Standard Error (SE)	% 95 Confidence Interval Lower Limit	Upper Limit
0,031	0,657	0,511	112,668	68,935	0,047	-0,062	0,124

** p<.05, ** p<.01, *** p<.001*

In Table 2, the mean effect size of included studies in random effect model according to gender variable ES=0,031, Standard error of mean effect size 0,047, upper limit of confidence interval of mean effect size 0,124 and lower limit -0,062 are calculated. Calculated mean effects size value is not significant (Z= 0,657, p>.05). In this case, it is revealed that there is no difference between male and female about attitudes towards computer-assisted instruction.

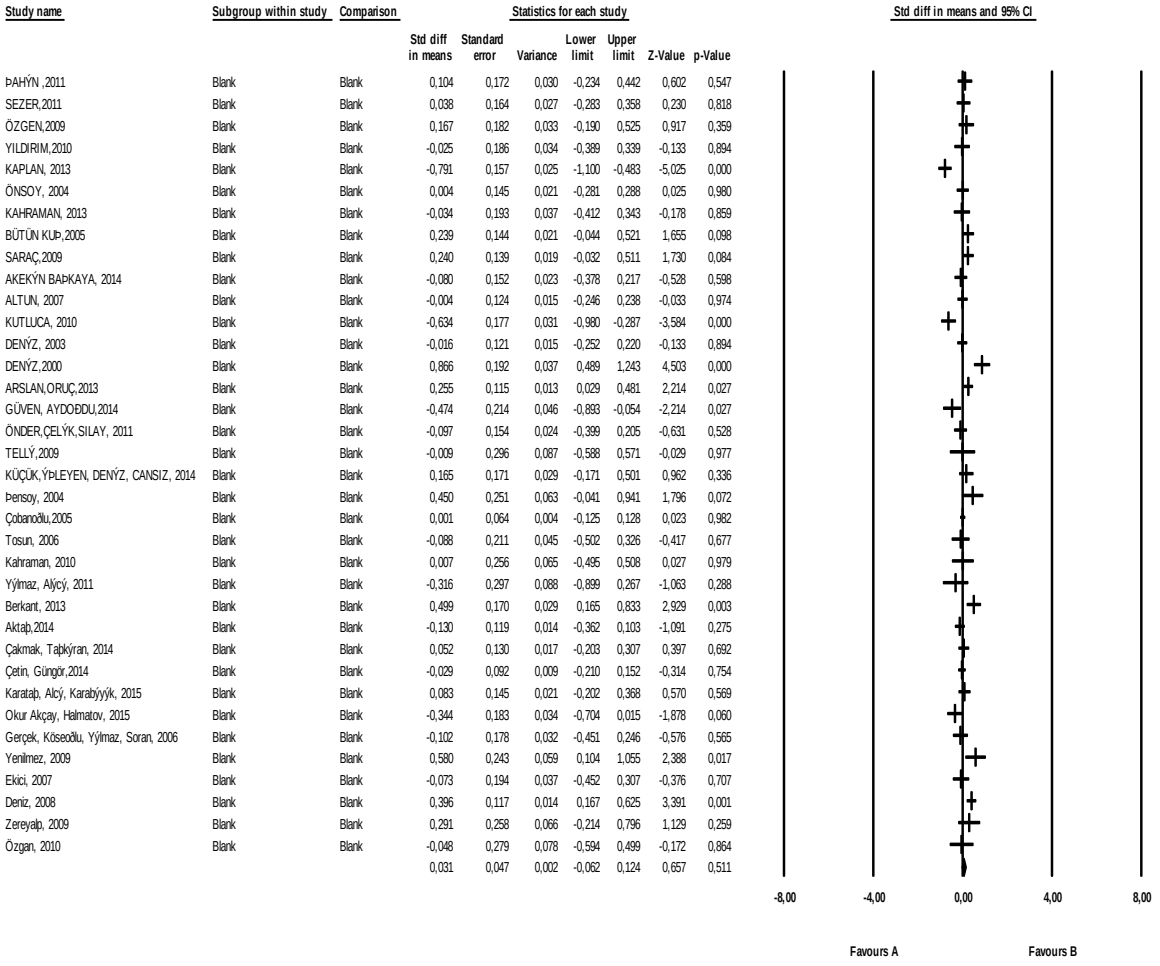


Figure 2. The gender effect on attitudes towards computer-assisted teaching forest plot

3.3 Publication Bias

The practice of publishing only studies with significant results is widespread. It is known that including only these studies into meta-analysis leads to publication bias. Additionally, bias of included studies can reduce the validity of that study (Borenstein, Hedges & Rothstein 2007; Ustun & Eryilmaz, 2014). One of the ways of measuring the publication bias is creating a funnel plot. According to funnel plot, all studies are expected to be placed in funnel lines symmetrically. The studies which are out of the funnel lines lead to a publication bias. The more scattering the number of studies which are out of the lines, the more publication bias there is (Dincer, 2014). There is a funnel plot of publication bias below.

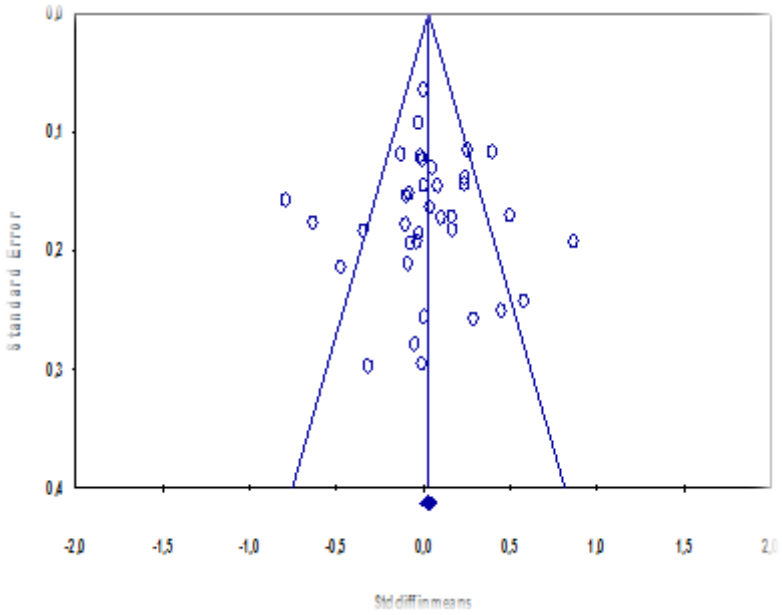


Figure 3. Funnel plot of publication bias

When looking at Figure 3, it can be seen that most of the studies are inside of the lines. In this case, it can be said that included studies contribute to the meta-analysis.

When the funnel plot is analyzed, it can be seen that symmetry is irregular and the studies on the left hand side are more numerous insomuch as there are some studies out of the lines of funnel plot. This creates heterogeneity. When it is analyzed by Duval and Tweedie's trim and fill technique, it is understood that 6 studies should be moved to the right side from the left side for symmetry. The new mean effect size after the moving process will be 0,120.

3.4 Investigating the Effects of Gender on Attitudes towards Computer-assisted Instruction According to Moderator Variables

In Table 3, moderator variables which are publication type, sample type and geographical region effect are examined.

Table 3. The effect of gender on attitudes towards computer-assisted instructions (moderator variables)

Moderator Variables	Moderator Variable Levels	N	ES	SE	Z	p	Lower Limit	Upper Limit	Q	sd
Publication type	article	19	0,033	0,076	0,434	0,665	-0,116	0,182		
	Master Thesis	16	0,031	0,060	0,515	0,607	-0,087	0,149	0,010	2
	PhD	1	0,007	0,256	0,027	0,979	-0,495	0,508		
Sample type	Teacher	16	0,040	0,069	0,582	0,561	-0,095	0,176	0,032	1
	Pre-service teacher	20	0,023	0,068	0,340	0,734	-0,110	0,156		
Geographical Region	Central Anatolia	9	0,038	0,084	0,455	0,649	-0,127	0,204		
	Marmara	9	0,198	0,099	**2,006***	0,045	0,005	0,391		
	Aegean	4	-0,015	0,053	-0,292	0,771	-0,119	0,088		
	East	6	-0,140	0,154	-0,914	0,361	-0,441	0,161	7,373	6
	Southeastern	1	0,167	0,182	0,917	0,359	-0,190	0,525		
	Mediterranean	3	0,201	0,223	0,902	0,367	-0,236	0,639		
	Black Sea	4	-0,177	0,177	-1,000	0,318	-0,525	0,170		

** p<.05, ** p<.01, *** p<.001*

When the table is analyzed, there is a significant difference (p<.05), in terms of geographical region variable and there is no significant difference according to the publication and sample type (p>.05). It can be seen that the geographical region which has the highest mean effect size is Marmara and it is on behalf of males.

4. Discussion, Result and Suggestions

36 studies were included in this study focusing on the effect of gender on attitudes towards computer-assisted instruction. The data was collected and combined from two sample group as 3297 males and 4029 females –a total of

7326 participants. A meta-analysis was conducted in order to find a general result.

The results were reached by using the random effect model because there is heterogeneity among the studies. According to this, there is no significant effect of gender on the attitudes towards computer-assisted instruction. According to Topcu (2009); in our country, males' attitudes towards computers are more positive compared to females. However, when it comes to the results of his study, little difference, according to Cohen, and insignificant difference, according to Thalheimer emerged. Another study which supports the result of Topcu's (2009) study is Whittley's study (1997). Whittley (1997) confirmed that there is no gender effect on the attitude and behavior towards computers. From this point of view, it can be interpreted that the impression that attitudes of males in Turkey are more positive towards computer and computer-assisted instruction has no scientific basis. With the developing technological era, now every individual can utilize computers and computer-assisted instructions. It is obvious that this situation has nothing to do with gender. Therefore considering the gender factor is useless while analyzing the attitude in every computer-assisted instruction study.

According to the results of publication bias, most of the included studies are in the lines of the funnel, but not symmetrically. This situation can lead to a thought that there is publication bias. Manifestos presented in the congress or symposium not published or a situation when the data of these studies is unavailable results in the file drawer problem (Ustun and Eryilmaz, 2014). Not including and not publishing the studies which have no significant results or of which data is unavailable to the analysis causes the publication bias. In this regard, if other manifesto studies and studies which are considered as not published because of the lack of significant statistic results can be gathered, reanalysis can be done.

Publication type, sample type and geographical region are determined as moderator variables with the presumption that they can create a difference. Any difference cannot be identified according to publication and sample type at the end of the research. So, it can be said that time and sample numbers do not create a difference in articles and theses. Likewise, there is no difference between teachers and pre-service teachers deriving from experience. In a fast developing technology era, age and experience are now closer to each other resulting in a smaller gap between them. Nonetheless, according to geographical region analysis, there is little difference on behalf of males in the Marmara region according to the classification of Thalheimer and Cook (2005).

The gender factor is a crucial variable for learning and teaching activities. However, with this research, it becomes obvious that this factor does not create a huge difference. Every teacher and pre-service teacher comes to the classroom environment with similar preparedness for computers. The results of Whitley's meta-analysis study (1997) confirm this inference. In his study which was conducted with adults and university students, he proposes that there is no relevance between gender and attitudes towards computers. The studies which were conducted during those years in our country demonstrate that there was a significant difference on behalf of males (Ustundag, 2001). However, it is obvious that females are interested in technology and computers now. This case should affect the teaching/learning environment.

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