Gender differences in computer-related achievement, anxiety and attitude: A meta-analysis in Turkey sample

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Abstract

The aim of this study is to analyze the gender differences on computer-related achievement, anxiety and attitude in Turkey sample. With an aim to combine the results obtained from the independent studies conducted on computer achievement, computer anxiety and computer-related attitude; three different meta-analysis studies were conducted. Various criteria were used in order to determine which studies were going to be included in meta-analysis. Within this context, both Turkish and English studies conducted during 2000-2014 were analyzed; 16 studies on achievement, 17 studies on anxiety and 30 studies on attitude from Turkey sample containing sample size, standard deviation and average values were included in the research. The studies containing the relevant data were analyzed with random effects model. As result of the study, effect size of gender differences for computer achievement, computer anxiety and computer-related attitude were found as 0.012, 0.237 and 0.114 respectively. The values obtained were evaluated according to the classification made by Thalheimer and Cook [30], it was detected that effect sizes regarding gender differences for computer achievement and computer-related attitude were negligible but effect sizes regarding gender differences for computer anxiety were small in favor of male individuals. Consequently, it was determined that there was no difference in computer achievement and computer-related attitude of male and female individuals and the anxiety levels of females are higher than the anxiety levels of males.

Keywords: computer achievement, computer anxiety, computer-related attitude, gender differences, meta-analysis

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1. Introduction

In an era which is shaped by rapid technological developments, societies are becoming increasingly more dependent on information technology, particularly on communication and computer technology [19]. With this dependency, computers are used in almost every business field. For this reason, the ability to use computers, has become a crucial component in the educational process [22]. Consequently, the effective use of information technology has become an essential requirement due to its role as a tool for human advancement [19]. With this essential requirement, the studies on the use and production of computer technologies have been conducted (cited from Schneiderman (1980) and Card et al. (1983) by Whitley [34].

Computer literacy courses at different levels took their place in schools in order that computer literacy could accomplish the essential objective. Computer literacy, generally, contains fundamentals of the information and computer technologies [32]. Beyond the computer literacy, in today's world where we come across with a new computer-based technology every day, it is a necessity for individuals to comply with these technologies [12]. Furthermore, human and computer interaction is affected by the characteristics of the computer system and the person using it (cited from Schneiderman (1980) and Card et al. (1983) by Whitley [34].

1.1. Computer Achievement

Computer, which is an education environment, has gained its place in three different ways; these are learning through computer, computer-assisted learning and learning the computer [1, 18, 17]. In this study, under the title of learning the computer; levels of the computer achievement, information technologies achievement, programming achievement, use of office programs achievement and web design achievement are all discussed as computer achievement.

When addressing computer achievement, it should be considered that there is a positive correlation between achievement and attitude because attitudes play an important role in the perception of information (cited from Prokop et al. (2007) and Tuysuz (2010) and Festus and Ekpete (2012) by Baser [2].

1.2. Computer Anxiety

In our day, we interact with many different technologies. When computer technologies have to be used, the feeling emerging as fear and apprehension of using these tools can be defined as computer anxiety [6]. Computer anxiety is one of the most important factors that can affect computer achievement of students. Therefore, it specifies to what extent computers can be used by individuals effectively. From this point of view, it is thought that computer anxiety is an important determinant in computer achievement [22].

1.3. Computer-Related Attitude

Studies have suggested that students' computer-related attitude has a strong correlation with their achievement in learning to use computer technologies [20]. Computer-related attitude is defined as the mental processes which lie behind the opinions, feelings and attitudes regarding the activities containing individual's use of computer and which take its source from individual's experiences relating computer [10, 12, 3]. For this reason, when individuals spend more time on computer, their computer-related attitude shows a positive tendency [7].

1.4. The Study on Computer Achievement, Computer Anxiety and Computer-Related Attitude

With an aim to reveal the effects of gender differences on computer achievement, computer anxiety and computer-related attitude, a meta-analysis study has been conducted by utilizing from the researches carried out in Turkey. In order to detect the differences in terms of gender, 16 studies on computer achievement, 17 studies on computer anxiety and 30 studies on computer-related attitude were

analysed. The answers of the following questions were looked for; "is gender effective on computer achievement?", "is gender effective on computer anxiety?", "is gender effective on computer-related attitude?"

2. Method

In this study, meta-analysis method was used in order to calculate the effect size of gender on computer achievement, computer anxiety and computer-related attitude. Meta-analysis can be defined as an analysis of previous analyses and is a statistical method used to combine the results of similar studies with an aim to come to a general conclusion by utilizing from the data collected from different scientific studies carried out in a certain field [21, 9, 29, 5]. In order to carry out meta-analysis, first of all, appropriate studies should be determined and then the studies to be included in the research process should be selected. The obtained data should be coded and their effect sizes should be calculated in order to analyze the selected studies correctly. Statistical analysis of the obtained effect sizes are carried out and interpreted. Finally, meta-analysis process resulted by drawing a conclusion according to the interpretation of the findings [14, 15].

3. Implementation of Meta-Analysis

3.1. Data Collection

The study process was initiated with the hypothesis "gender has a significant effect on computer achievement, computer anxiety and computer-related attitude". Based on this hypothesis, all data obtained from the graduate theses, papers and articles by making literature search through YOK Database and electronic databases were combined on a worksheet. In the data collection process, literature search was performed with Turkish and English keywords. For computer achievement, keywords such as "computer achievement", "achievement regarding computer", "programming achievement", "algorithm achievement", "computer hardware achievement" and "word processor achievement" were used. For computer anxiety, "anxiety regarding computer" and "computer anxiety" keywords were used. For computer-related attitude, "computer-related attitude", "attitude towards computer" and "computer attitude" keywords were used.

3.2. Inclusion and Exclusion Criteria

Determination of which studies to include in the research process is a very important point in terms of obtaining effective and positive results [5, 23, 31, 27, 25, 15]. Inclusion criteria are given below:

1- The studies to be included in the analysis process were chosen in a way to cover the period between 2000 and 2014.

2- The studies prepared as thesis or published papers and articles were included in the analysis process.

3- Every study included in the analysis process should have a control or comparison group in order that standardized effect size can be calculated in meta-analysis study [28]. Because the effect of gender on computer achievement, computer anxiety and computer-related attitude is analyzed in our research, the studies providing results according to the gender variable were included in the analysis process.

4- The studies providing average (M), standard deviation (SD) and sample size (N) belonging to study group were included in the analysis process. The studies that do not provide these were not included in the analysis process.

3.3. Coding Method

A coding method should be used to carry out the analysis process properly and to use the studies in comparisons [5]. Coding method should be general to cover all studies but specific to reveal the differences of studies [5, 24]. The characteristics of the work area where the coding method was used in the current study are specified below:

1. In order to have a clear view of the study's identity in every phase of the process, a template including information such as "Code of the Study", "Name of the Study", "Writer of the Study", "Publication Date of the Study", "Publishing Journal of the Study" and "Brief Description of the Study" was created on the work area and the information of all studies included in the research process were added to this template.

2. In order to detect the content of the study and make comment more comfortably during and at the end of the research process, information such as the ages and education levels of the participants included in the study or the description of computer technologies subdomain that a study belongs to (programming, algorithm, word processor, excel, hardware etc.) were added to the worksheet.

3. Descriptive statistics like average (M), standard deviation (SD) and sample size (N) were detected and added to the work area.

3.4. Data Analysis

In this research, the studies containing the relevant data were analyzed with random effects model. At the end of the meta-analysis, effect sizes are obtained quantitatively and classifications are used when interpreting what they mean [8]. During the classification of effect sizes, interpretations were made according to the classification created by Thalheimer and Cook [30] shown at the following list:

• -0.15≤ Effect size value < 0.15 negligible,

• 0.15≤ Effect size value < 0.40 small,

• 0.40≤ Effect size value < 0.75 medium,

• 0.75≤ Effect size value < 1.10 large,

• 1.10≤ Effect size value < 1.45 very large,

• 1.45≤ Effect size value huge

4. Findings

Descriptive statistics regarding the studies included in the meta-analysis process are shown in Table 1. When the publication year is taken into account in Table 1, it can be seen that the studies regarding the effect of gender on computer achievement were mostly carried out between 2006, 2009 and 2013 (18.75%). The studies regarding the effect of gender on computer anxiety were mostly carried out in 2013 (23.5%) and the studies regarding the effect of gender on computer-related attitude were mostly carried out in 2007 (20%).

When the publication type is taken into account, it is seen that the majority of the studies regarding the effect of gender on computer achievement were master's theses (93.75%), the majority of the studies regarding the effect of gender on computer anxiety were also master's theses (64.7%) and the majority of the studies regarding the effect of gender on computer-related attitude were articles (80%).

Table 1. Frequency and Percentage Statistics according to Publication Year and Publication Type Variables of the Studies

Variables	Achievement		Anxiety		Attitude	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Publication Year						

2000	0	0	0	0	1	3.3
2001	0	0	1	5.9	1	3.3
2003	0	0	1	5.9	3	10
2004	1	6.25	0	0	0	0
2005	1	6.25	2	11.8	3	10
2006	3	18.75	1	5.9	3	10
2007	0	0	2	11.8	6	20
2008	2	12.5	2	11.8	2	6.7
2009	3	18.75	0	0	2	6.7
2010	1	6.25	3	17.6	3	10
2011	1	6.25	0	0	3	10
2012	1	6.25	1	5.9	1	3.3
2013	3	18.75	4	23.5	1	3.3
2014	0	0	0	0	1	3.3
Publication Type						
Conference Paper	0	0	1	5,9	2	6.7
Journal Article	0	0	5	29.4	24	80
Master's Thesis	15	93.75	11	64.7	3	10
Doctorate Thesis	1	6.25	0	0	1	3.3

Homogeneous distribution values, average effect sizes and confidence intervals of the studies included in the meta-analysis according to their statistical models are given in Table 2. In fixed effects model of the gender's effect on computer achievement, it can be stated that it is positive with its 0.036 effect size. As a result of homogeneity test, Q statistical value was calculated as 69.763. Critical value is accepted as 24.996 with 15 degree of freedom at 95% significance level from chi-square table. Because the calculated Q statistical value (69.763) is higher than the critical value 24.996, it can be stated that the distribution of effect sizes are heterogeneous (p<0.05). Since the distribution in the study is heterogeneous, analyses were carried out which are appropriate for random effects model and the removal of complexities resulting from the heterogeneity of the sample was targeted [35]. From this point of view, the effect of gender on computer achievement was compared according to random effects model. As a result of the calculations, the data in 16 studies included in meta-analysis according to random effects model was calculated as follows; standard error as 0.106, lower limit and upper limit of 95% confidence interval as -0.195 and 0.220 respectively and average effect size as 0.012. It was also observed that computer achievement was in favor of male students. When the calculated effect size is considered (d=0.012), it is seen as negligible according to the classification made by Thalheimer and Cook [30]. As a result of z test calculations made with the purpose of statistical significance, z was found equal to 0.117. It was determined that this value was not significant statistically at the level of 0.05 (z=0.117, p>0.05).

In fixed effects model of the gender's effect on computer anxiety, it can be stated that it is negative with its -0.126 effect size. As a result of homogeneity test, Q statistical value was calculated as 944.307. Critical value is accepted as 26.296 with 16 degree of freedom at 95% significance level from chi-square table. Because the calculated Q statistical value (944.307) is higher than the critical value 26.296, it can be stated that the distribution of effect sizes are heterogeneous (p<0.05). From this point of view, the effect of gender on computer anxiety was compared according to random effects model. As a result of the calculations, the data in 17 studies included in meta-analysis according to random effects model was calculated as follows; standard error as 0.204, lower limit and upper limit of 95% confidence interval as -0.164 and 0.637 respectively and average effect size as 0.237. It was also observed that computer anxiety was in favor of male students. When the calculated effect size is considered (d=0.237), it is seen that it has a small effect according to the classification made by Thalheimer and Cook [30]. As a result of z test calculations made with the purpose of statistical significance, z was found equal to 1.159. It was determined that this value was not significant statistically at the level of 0.05 (z=1.159, p>0.05).

In fixed effects model of the gender's effect on computer-related attitude, it can be stated that it is positive with its 0.110 effect size. As a result of homogeneity test, Q statistical value was calculated as 56.31. Critical value is accepted as 42.557 with 29 degree of freedom at 95% significance level from chi-square table. Because the calculated Q statistical value (56.31) is higher than the critical value 42.557, it can be stated that the distribution of effect sizes are heterogeneous ($p < 0.05$). From this point of view, the effect of gender on computer-related attitude was compared according to random effects model. As a result of the calculations, the data in 30 studies included in meta-analysis according to random effects model was calculated as follows; standard error as 0.033, lower limit and upper limit of 95% confidence interval as 0.049 and 0.180 respectively and average effect size as 0.114. It was also observed that computer-related attitude was in favor of male students. When the calculated effect size is considered (d=0.114), it is seen as negligible according to the classification made by Thalheimer and Cook [30]. As a result of z test calculations made with the purpose of statistical significance, z was found equal to 3.411. It was determined that this value was statistically significant at the level of 0.05 (z=3.411, $p < 0.05$).

Table 2. Homogeneous Distribution Value of the Studies included in the Meta-Analysis according to Effect Models, Average Effect Size and Confidence Intervals Table

Subject	Model Type	N	Z	Total Heterogeneity Value (Q)	Average Effect Size (ES)	Average Confidence	Interval for Effect Size
Achievement	Fixed	16	0.835	69.763	0.036	-0.048	0.120
	Random		0.117		0.012	-0.195	0.220
Anxiety	Fixed	17	-4.909	944.307	-0.126	-0.177	-0.076
	Random		1.159		0.237	-0.164	0.637
Attitude	Fixed	30	5.673	56.31	0.110	0.072	0.148
	Random		3.411		0.114	0.049	0.180

5. Discussion and Conclusion

One of the most important variables in societies where there is cutthroat competition in order to meet the requirements of the information era is information literacy. The most powerful indicator of information literacy is computer achievement. While there are many factors affecting computer achievement, there are lots of studies in literature arguing that computer anxiety and computer-related attitude are directly related to computer achievement [22]. Therefore, the factors affecting computer achievement, computer anxiety and computer-related attitude are frequently studied in the literature. Among these factors, gender is one of the most studied factors especially in the fields of psychology and computer education [34]. In general, computer achievement of male individuals are higher, their computer anxieties are lower and their computer-related attitudes are more positive [34, 31]. From this point of view, in the study, three different meta-analysis studies were carried out in Turkey sample with an aim to determine the effect of gender on computer achievement, computer anxiety and computer-related attitude.

Effect sizes of 16 academic studies for computer achievement, 17 academic studies for computer anxiety and 30 academic studies for computer-related attitude were calculated in accordance with the inclusion criteria specified in the study. Q statistical values calculated in this study are 69.763, 944.307 and 56.31 respectively. Since these values are higher than critical values, it can be stated that distribution of effect sizes is heterogeneous ($p < 0.05$). Because the distributions are heterogeneous, analyses appropriate for random effects model were performed. According to the findings shown in Table 2, computer achievement, computer anxiety and computer-related attitude are in favor of male students. When the calculated effect size values are taken into consideration respectively (d=0.012, d=0.237, d=0.114), according to the classification made by Thalheimer and Cook [30] it is seen that gender has a negligible effect on computer achievement and computer-related attitude and a small effect on computer anxiety. As a result of the z test performed for statistical significance, it is seen that while there is not a significant difference in computer achievement and anxiety, there is a significant difference in computer-related attitude (z=0.117, $p > 0.05$; z=1.159, $p > 0.05$; z=3.411, $p < 0.05$).

While the results of the study show that the effect of gender on computer achievement, computer anxiety and computer-related attitude are in favor of male students, this effect is negligible or small. This result is consistent with the results of many studies in literature [34, 4, 16, 26, 13, 31]. However, there are also studies offering different results. For example, today some findings reveal that the levels of male individuals' technology adoption significantly differentiate from the levels of female individuals' technology adoption [11]. According to the statistics of TUIK (Turkish Statistical Institute) [33], while computer use rate of males is 64%, this rate is 45.6% for females. Although the effect of gender on computer achievement, computer anxiety and computer-related attitude is small, this difference increases in actual usage behavior. In our country, there is not difference between males and females in terms of attitude and achievement and although this is an advantage for increasing computer use rates, studies should be conducted in order to remove the difference in use rates which result in digital divide.

References

[1] Alkan, C. (1986). Bilgisayarların Egitimde Kullanimi. *Egitim ve Bilim*, *11*(62), 9-15, October.

[2] Baser, M. (2013). Attitude, Gender and Achievement in Computer Programming. *Middle-East Journal of Scientific Research, 14*(2), 248-255.

[3] Birisci, S., Metin, M., & Demiryurek, G. (2011). İlkogretim ogretmenlerinin bilgisayar ve internet kullanımına yonelik tutumlarının incelenmesi: (Artvin ili ornegi). *Egitim Teknolojileri Arastırmaları Dergisi*, 2(4).

[4] Brosnan, M., & Lee, W. (1998). A cross-cultural comparison of gender differences in computer attitudes and anxieties: The United Kingdom and Hong Kong. *Computers in Human Behavior*, *14*(4), 559-577.

[5] Camnalbur, M., & Erdogan, Y. (2008). A meta analysis on the effectiveness of computer-assisted instruction:Turkey sample. *Educational Sciences:Theory & Practice*, *8*(2), 497-505.

[6] Çevik, V., & Baloglu, M. (2007). Okul yoneticilerinin bilgisayar kaygisi duzeylerinin çesitli degiskenler açısından incelenmesi. *Kuram ve Uygulamada Egitim Yonetimi, 52,* 547-568.

[7] Deniz, L., (2000). Ogretmen Adaylarinin Bilgisayar Yasantilari ve Bilgisayar Tutumlari, *Marmara Universitesi Ataturk Egitim Fakultesi Egitim Bilimleri Dergisi*, *12*, 135-166.

[8] Dinçer, S. (2014). *Egitim Bilimlerinde Uygulamali Meta- Analiz*. *Pegem Akademi*, Ankara, ISBN: 978-605-364-844-4.

[9] Ergene, T. (2003). Sınav kaygisini azaltma programlarinin etkililigi: Bir meta analiz calismasi. *VII. Ulusal Psikolojik Danısma ve Rehberlik Kongresi*, 09-11 July, İnonu University, Malatya.

[10] Erkan, S. (2004). Ogretmenlerin Bilgisayara Yonelik Tutumlari Uzerine Bir İnceleme. *Kırgızistan-Turkiye Manas Universitesi Sosyal Bilimler Dergisi*, *12*(6), 141-145.

[11] Esgin, E., Çetinkaya, A., & Agaoglu, M. (2015). Kamu kurumunda kullanicilarin farkli ozelliklerinin e-donusumun kabulune etkilerinin incelenmesi, *International Journal of Human Sciences, 12*(1), 761-789.

[12] Gerçek, C., Koseoglu, P., Yilmaz, M., & Soran, H. (2006). Ogretmen adaylarinin bilgisayar kullanimina yonelik tutumlarının çesitli degiskenler acisindan incelenmesi, *Hacettepe Universitesi Egitim Fakultesi Dergisi*, *30,* 130-139.

[13] Hasançebioglu, T. (2002). Ogretmenlerin Liderlik Stilleri, Bilgisayar Tutumları ve Aralarındaki İliskinin İncelenmesi. M.Sc., Marmara University, Institute of Educational Sciences, İstanbul.

[14] Hoffler, T. N., & Leutner, D. (2007). Instructional animation versus static pictures: A meta-analysis. *Learning and instruction*, 17(6), 722-738.

[15] Kablan, Z., Topan, B., & Erkan, B. (2013). Sınıf İçi Ogretimde Materyal Kullanımının Etkililik Duzeyi: Bir Meta-Analiz Çalısması. *Kuram ve Uygulamada Egitim Bilimleri,* 13(3), 1629-1644.

[16] Kadijevich, D. (2000). Gender differences in computer attitude among ninth-grade students. *Journal of Educational Computing Research*, 22(2), 145-154.

[17] Keser, H. (1991). Egitimde Nitelik Gelistirmede Bilgisayar Destekli egitim ve Ders Yazılımlarının Rolu. Egitimde Nitelik Gelistirme. Egitimde Arayıslar 1. Sempozyumu Bildiri Metinleri. İstanbul: 13-14 Nisan 1991; Kultur Koleji Yayınları, No:1, 178-183.

[18] Knezek, G. A., Sidney, L. R., & P. Scannell. (1988). A Taxonomy for Educational Computing. *Educational Technology*, *28*(3), 15-19, March.

[19] Levine, T., & Donitsa-Schmidt, S. (1998). Computer use, confidence, attitudes, and knowledge: A causal analysis. *Computers in human behavior*, *14*(1), 125-146.

[20] Liu, L., Maddux, C., & Johnson, L. (2004). Computer attitude and achievement: is time an intermediate variable?. *Journal of Technology and Teacher Education*, *12*(4), 593-607.

[21] Lyons, L. C. (1998). Meta - Analysis: Methods of Accumulating Results across Research Domains. Manassas, VA, USA. Retrieved 11 11, 2015, from http://www.lyonsmorris.com/MetaA/macalc/MApaper.pdf

[22] Marcoulides, G. A. (1988). The relationship between computer anxiety and computer achievement. *Journal of Educational Computing Research, 4*(2), 151-158.

[23] Okursoy, F. G. (2009), Kavram haritaları ogretim stratejisinin ogrenci basarısına etkisi: Bir meta analiz çalısması. M.Sc, Marmara University, Institute of Educational Sciences, Istanbul.

Esgin, E., Elibol, M., & Daglı, M. (2015). Gender differences in computer-related achievement, anxiety and attitude: A meta-analysis in Turkey sample. *Global Journal of Computer Sciences: Theory and Research*. *6*(1), 02-09.

[24] Ozcan, S. (2008). Egitim yoneticisinin cinsiyet ve hizmetiçi egitim durumunun goreve etkisi: bir meta analitik etki analizi, PhD Thesis, Marmara University, Istitute of Educational Sciences, İstanbul.

[25] Ozcan, S., & Bakioglu, A. (2010). Bir meta analitik etki analizi: Okul yoneticilerinin hizmetiçi egitim almalarının goreve etkisi. *Hacettepe Universitesi Egitim Fakultesi Dergisi*, *38*, 201-212.

[26] Schumacher, P., and Morahan-Martin, J. (2001). Gender, Internet and computer attitudes and experiences. *Computers in human behavior*, *17*(1), 95-110.

[27] Sahin, İ. (2010). Curriculum assessment: Constructivist primary mathematics curriculum in Turkey. *International Journal of Science and Mathematics Education*, *8*(1), 51-72.

[28] Sahin, M. C., & Tekdal, M. (2005). İnternet tabanlı uzaktan egitimin etkililigi: Bir meta-analiz çalısması. Akademik Bilisim Konferansı 2005, Gaziantep.

[29] Sahin, M.C. (2005). Internet tabanli uzaktan egitimin etkililigi: bir meta analiz çalısması, M.Sc., Institute of Social Sciences, Çukurova University, Adana.

[30] Thalheimer, W., & Cook, S. (2002). How to calculate effect sizes from published research: A simplified methodology. *Work-Learning Research*, 1-9.

[31] Topçu, P. (2009). Cinsiyetin bilgisayar tutumu uzerindeki etkisi: Bir meta analiz çalısması, M.Sc., Marmara University, Institute of Educational Sciences, İstanbul.

[32] Tsai, M. J., & Tsai, C. C. (2003). Student computer achievement, attitude, and anxiety: The role of learning strategies. *Journal of Educational Computing Research*, *28*(1), 47-61.

[33] TUIK. (2015). 2015 Yılı Hane Halkı Bilisim Teknolojileri Kullanim Arastirmasi Haber Bulteni, Ankara: Turkiye İstatistik Kurumu.

[34] Whitley, B. E. (1997). Gender differences in computer-related attitudes and behavior: A meta-analysis. *Computers in Human Behavior*, *13*(1), 1-22.

[35] Yıldız, N. C. (2002). *Verilerin degerlendirilmesinde meta analizi.* M.Sc., Marmara University, Institute of Pure and Applied Sciences, İstanbul.