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Gender Effects on Curriculum Elements Based On Mathematics and Science and Technology Teachers' Opinions: A Meta-Analysis for Turkish Studies

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Abstract

The purpose of this study is to investigate the gender effect on elementary mathematics and science and technology teachers' opinions regarding curriculum elements which are objectives, content, learning situation and evaluation. Meta-analysis was used in order to analyze data. Two articles, 11 master and one doctorate thesis which were conducted between 2005-2015 were studied in accordance with the inclusion criteria. Gender effect on curriculum elements was investigated based on the elementary schools mathematics and science and technology teachers' opinions was investigated in the constructed coding. Standardized mean difference was used as effect size. ES values for objectives were found as 0.122, 95% CI=0.055-0.190; for content as 0.090, %95 CI= 0.015-0.0164; for learning situation as, 0.154, %95 CI= 0.069-0.239 and for measurement and evaluation as 0.137, %95 CI= 0.061 -0.214.

Keywords: curriculum evaluation, teachers' opinions, elementary school, curriculum elements', mathematics, science and technology, meta-analysis, random effects model, funnel plot, forest plot

1. Introduction

1.1 Problem

Curriculum evaluation, which includes information to make decisions such as accepting, changing or removing educational resources regarding curriculum, is generally described differently by scholars. Curriculum evaluation functions as a last and complementary link of curriculum development process as it designs the actualization level of objectives, collects data about effectiveness of curriculum via observation and various measurement tools, compares the gathered data with the curriculum effectiveness standards and decides; it is a process in fact (Ertürk, 1986; Erden; 1998, Demirel;2006). According to Richards, curriculum evaluation means gathering the necessary data systematically to make a decision about curriculum. Popham, on the other hand, emphasizes curriculum evaluation being a systematic process and continues describing systematic curriculum evaluation as a determination of value of education as a figure (Brown, 1990).

Curriculum evaluation contains obtaining information in order to judge the value of a program, product, process or particle and to use the alternative approaches to achieve certain targets (Worthen& Sanders, 2011cited byYasar& Kaya, 1997). Varış (1996) argues that a curriculum as a written material can only be measured by its success in application. In order to decide whether a curriculum in practice is successful might be determined if a person, who has been exposed to the program, has gained the expected knowledge, skills and attitudes.

According to Ertürk (1986) curriculum evaluation helps teachers by regulating current education practices, helping educators to raise standards, motivating students for further learning and illuminating educators about the need of students for further learning and also help students and all educators by providing a real scenario for works and possible products.

Curriculum evaluation contributes to education field by being a tool for teacher training as well as helping to improve current curriculum or to develop a new one. Besides, curriculum evaluation provides outstanding feedback regarding the efficiency, drawbacks and breakdowns of a curriculum in use. In order to benefit from those feedbacks effectively, it is essential to assess acquisitions, content, learning situation and evaluation elements separately and check consistency

between each element with acquisitions. This process should be maintained by the teachers who are responsible for curriculum practice because whether a curriculum will be a success or not mainly depends on teacher qualifications as she/he is the one who works with the curriculum. It is quite important to revise curriculum based on teachers' opinions with an objectives to draw a path for education.

When curriculum development models mentioned in literature are studied, it is clear that curriculum evaluation is the last phase of the process (Tyler, 1949; Taba, 1962; Wulf & Schave, 1984).

Curriculum evaluation process can be conducted in different ways based on the evaluators' knowledge, skills and evaluative theories. Those different processes can be categorized under five titles according to their focus. Those categories are target driven, management driven, expert focused, consumer focused and participant focused. Most of the curriculum evaluation theories mentioned ignore both the environment in which curriculum evaluation is done and also the people who work with it (Yüksel & Sağlam, 2012). However, participant focused curriculum evaluation theory objectives to observe and identify people's expectations, problems and solutions.

Ertürk (1986) groups evaluation under two names which are criterion and objectives which the evaluation is for. Criterion evaluation has two sub-titles. The first one is norm referenced evaluation while the second one is objectives focused evaluation. If the evaluation is planned to be done according to target driven theory, it has also three sub-titles which are named as descriptive, formative and summative.

A curriculum can be evaluated by three steps by system approach. These steps are as follows; assessing input, process and output. It is quite true to declare that there are numerous new curriculum evaluation models besides those mentioned. Those models can be roughly listed as Objectives-Oriented Evaluation Model, Metfessel-Michael Evaluation Model, Provus Discrepancy Evaluation Model, Stake's Congruence-Contingency Model,Stafflebeam's CIPP, Model, Stufflebeam Total Evaulation Model, Eisner's Educational Critism Model, Stake's Responsive Evaluation Model and Demirel's Analytic Curriculum Evaluation Model (Demirel, 2006).

This study is considered substantial as it focuses on mathematics and science and technology teachers' opinions regarding mathematics and science curriculums and practices and thought useful as it might provide data and feedback for the process of mathematics and science curriculums development or improvement.

2. Method

2.1 Procedures

When literature at abroad and home is investigated, it is concluded that research papers have contradictions with each other even if they mention about the same topic. Researchers conducted with small samples fail to demonstrate a strong statistical proof (Yıldız, 2002). Researches with strong statistical values require time and expense. In this context, meta-analysis has been gaining importance and popularity day by day as it allows to combine small and large sampled researches and summarizes them. Meta-analysis method which is often used in medicine, education and psychology fields has become a statistical tool which helps researchers get published in really good indexes (Yıldız, 2009).

When literature was studied, no studies in curriculum evaluation field was found constructed with meta-analysis. Yet, it was observed that this method was frequently used on abroad while there is limited literature regarding education in Turkey. With this research, it is aimed to support literature in this field using meta-analysis.

2.2 Data Collection

EBSCO, ERIC, YOK, Ulakbim, arastirmax and ASOS databases were investigated in order to determine the gender effect on science and technology and mathematics teachers' opinions concerning curriculum.

Furthermore, leaflets and journals of education faculties were also included. 'Curriculum evaluation', 'elementary school', 'teachers' opinions', 'curriculum elements', 'mathematic course' and 'science and technology course' phrases were used as key words so as to find the researches.

Research data was collected in December 2015. There are plenty of articles, master and doctorate dissertations about teachers' opinions on curriculum of elementary school mathematics and science and technology lessons in Turkey. For the objectives of this study, only those who fit the inclusion criteria were selected. Eventually, 2 articles, 11 master thesis and 1 doctorate thesis were targeted for this study. 3 articles which fit the inclusion criteria were discarded because they were formed from thesis which were included to the study. Besides these, researches included in this study were selected according to the following rules:

2.3 Inclusion Criteria

Researchers studied in this paper were selected according to the criteria mentioned below:

1-Researches published between 2005-2015

2-Articles, proceeding, master and doctorate dissertations written in Turkey

3- Researches in which four elements of curriculum were studied according to the mathematics and science and technology teachers' opinions who worked in an elementary school

4- Researches in which gender was studied

5- Researches in which data regarding sample size, mean and standard deviation were provided about female and male.

Research characteristics were determined by coding the thesis included in this study. Research characteristics are independent variables which are considered to have an effect on the study and determined by researchers beforehand. In meta-analysis studies, several researches with different features are reviewed. In order to compare these different studies, it is important to code the variables.

2.4 Data Analysis

In order to analyze data, Group Difference Method which is one of the methods of group comparison meta-analysis was used. Standardized mean difference size effect method is conducted as mean score of independent variable in this study was not derived from the same scales. "Cohen d" is an effect size defining the difference between standardized mean scores. It shows how many standard deviation exists between group means. (Borenstein, 2009;Card, 2012).

In this study, Random Effects Model and Fixed Effect Model were used in order to determine the gender effect on curriculum elements according to the elementary school mathematics and science and technology teachers' opinions. Comprehensive Meta-analysis version 2 statistical package programs were used.

2.5 Purpose of This Research and Research Questions

Main purpose of this study is to investigate the acquisitions, content, educational background and evaluation elements of mathematics and science and technology lesson curriculums according to the gender using elementary stage mathematics and science and technology teachers' opinions. As a research method, studies in curriculum evaluation field were studied. As there has been observed no meta-analysis researches, it is considered to be useful to use this method.

Defined inclusion criteria was used and only thesis and articles which were conducted in Turkey were included to the study. Literature was limited to 2005 and afterwards. Thesis were searched in Council of Higher Education website, National Thesis Center. For articles, Google search engine was used (institute, faculty or institutional journals).

Two main questions to be answered in this heuristic designed study are as follows:

1- When the researches in curriculum evaluation field are studied, what is the effect of gender on curriculum elements according to the elementary school mathematics and science and technologyteachers' opinions?
2- Are those variables can be re-grouped by combining?

3. Findings

3.1 Gender Effect on Acquisitions

The purpose of this research is to determine the gender effect on one of the curriculum elements, acquisition. Before determining the effect size, whether there is a publication bias or not was checked. Funnel plot concerning this issue was shown in figure 1.

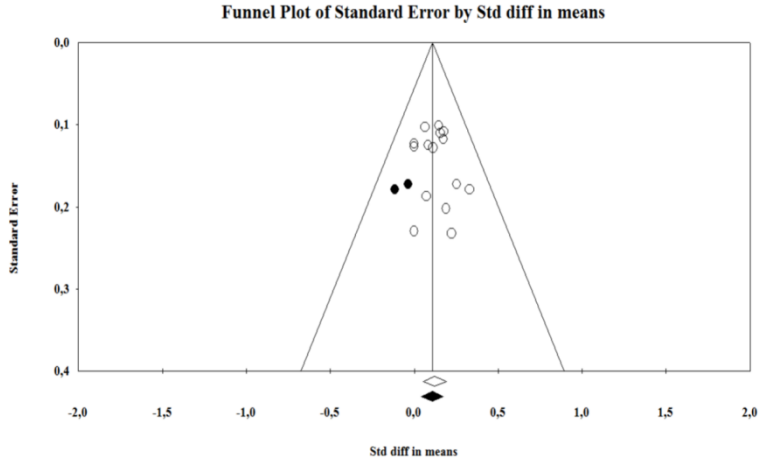

Figure 1. Funnel Plot for Educational Aims

In figure 1, it is seen that studies cumulated in the middle and the upper and also distributed on the left and the right side of the line.

When publication bias exists, the researchers are expected to reveal an asymmetric distribution. Orwin's Fail-Safe N was also calculated to test publication bias. This method calculates the possible missing researches (Borenstein et al, 2009). The safe N was found as 35. While studied researches in this study are 15, 35 more studied are needed in order to equate the effect size to 0. As a result, no more researches were included.

Table 1. Meta-Analysis Findings for Gender Effect on Educational Aims

Model used	Number of Studies	ES	Lower Limit of the Confidence Interval	Upper Limit of the Confidence Interval	Z-value	p-value	Q-value	p-value	I^2	τ^2
Fixed-Effect	15	0.122	0.055	0.0190	3.552	0.00	5.486	0.978	0.00	0.00

Table 1 reveals that effect size estimated for fixed-effect model and random- effects model is as 0.122. Female has positive effect size on objectives than male according to the results of both models. Calculated confidence interval for both models are observed to be the same.

Q- statistics knows as homogeneity test was found to be (5.486). This result suggests that each research included in this study have the same mean scores. Power of Q Statistic is influenced by the number of the researches included in the study and as the number of the researches increases, Q statistic increases.

I^2as a heterogeneity index (Petticrew& Roberts, 2006) shows the ratio of total variances belonging to the effect size. This statistic was calculated as 0% defining that there are no differences between the researches. I^2 , unlike Q- statistics, is not influenced by the number of the researches included.

τ^2which show the variance between predictions was observed as 0. This result supports that there is difference between the predictions made by fixed-effect model and random effects model.

In order to predictτ^2, Der Simonian-Laird is the most commonly used method. There are also other prediction methods such as Bayes, Empirical Bayes etc.

The confidence interval for both models remained the same. Q statistic was found to be (5.486). This suggests that all the researches included in the study have the same mean scores. As an indicator to the heterogeneity, and τ^2 values were calculated as 0.

Figure 2 shows the forest plot regarding effect size values of each educational aims.

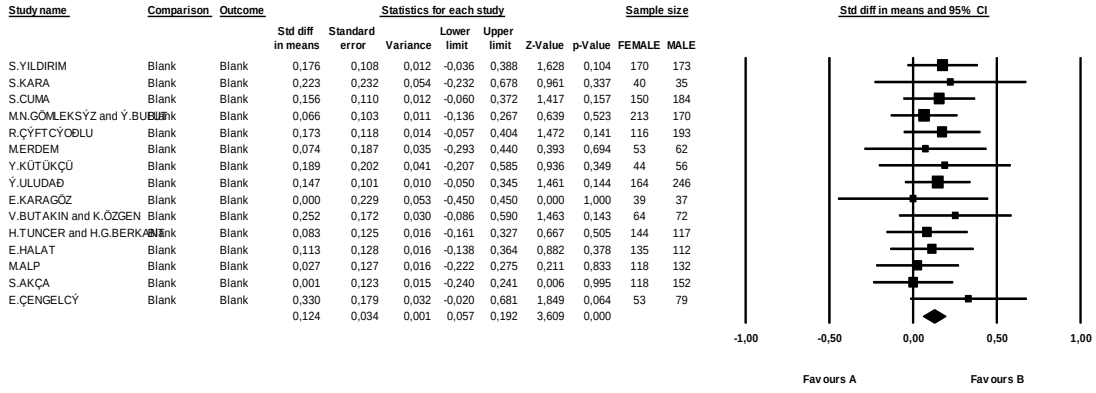

Figure 2. Forest Plot regarding Gender Effect on educational aims

Squares in the diagram show the effect size of this study while lines by the squares stands for the lowest and the highest limits of 95% confidence interval. Square size tells the weight according to the combined effect size. Figurelocated at the bottom of the diagram shows the combined effect size.

When the effect sizes of the researches included were investigated, the lowest effect size value was observed as 0.00 while the highest value 0.330. All 15 researches have positive effect. This positive effects reveal that female have a small effect than male in terms of acquisitions.

3.2 Gender Effect on Content

In order to determine if gender has an effect on content, publication bias was checked first. Funnel plot concerning this issue was shown in figure 3.

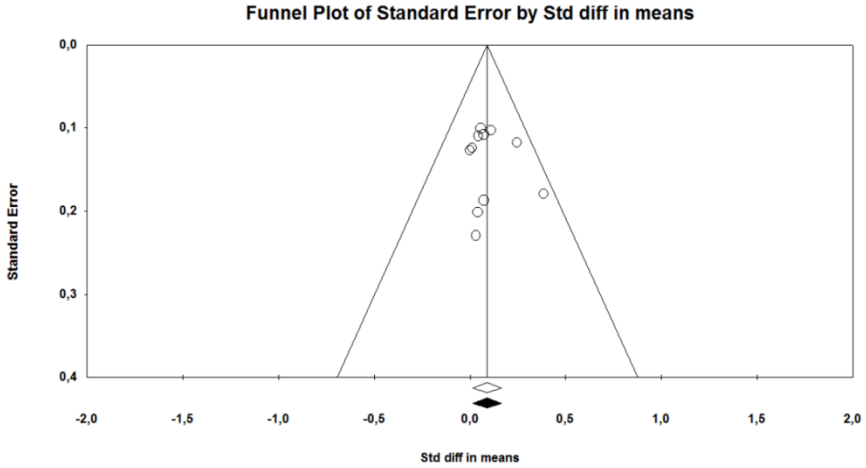

Figure 3. Funnel Plot for Content

In figure 3, it is seen that researches cumulated in the middle and the upper and also distributed on the left and the right side of the line symmetrically. Orwin's Safe N was calculated. As a result, no more researches were included.

Table 2 shows that effect size estimated for fixed-effects model and random effects model is as 0.090. Female have positive effect size on content than male according to the results of both models. Confidence interval calculated for both models are observed to be the same.

Table 2. Meta-Analysis Findings for Gender Effect on Content

Model used	Number of Studies	ES	Lower Limit of the Confidence Interval (95 %)	Upper Limit of the Confidence Interval (95%)	Z-value	p-value	Q-value	p-value	I^2	τ^2
Fixed-effect	12	0.090	0.015	0.0164	2.366	0.0018	5.856	0.883	0.00	0.00

Q statistic was found to be (5.486). This result suggests that each research included in this study have the same mean scores. As an indicator to the heterogeneity, I^2 and τ^2 values were calculated as 0. Figure 4 shows the forest plot regarding effect size values of each research.

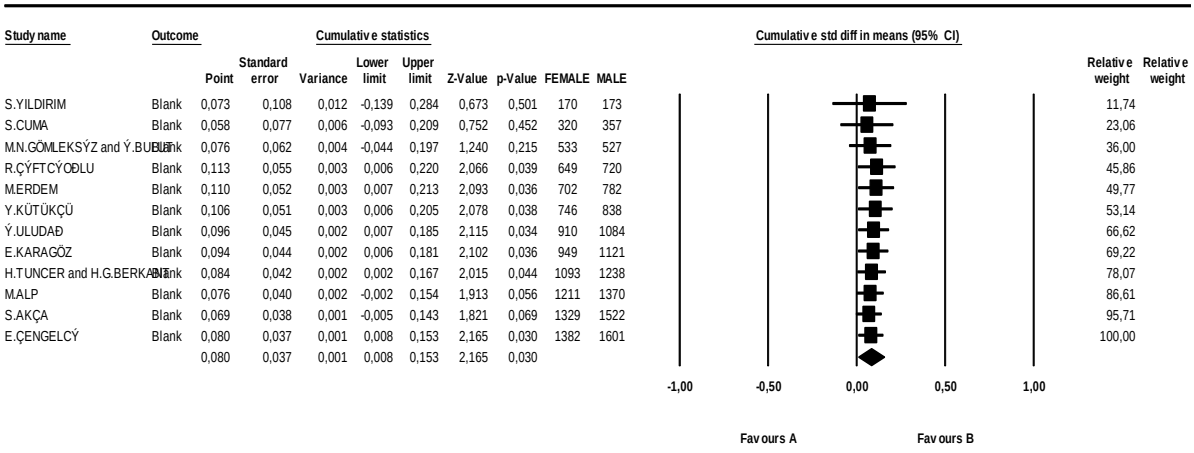

Figure 4. Forest Plot regarding Gender Effect on Gender Effect

When the effect sizes of the researches included were investigated, the lowest effect size value was observed as 0.13 while the highest value 0.386. All 12 researches have positive effect. This positive effects reveal that female have a postive effect than male in terms of content.

3.3 Gender Effect on Educational Background

In order to determine if gender has an effect on educational background, publication bias was checked first. Funnel plot concerning this issue was shown in figure 5.

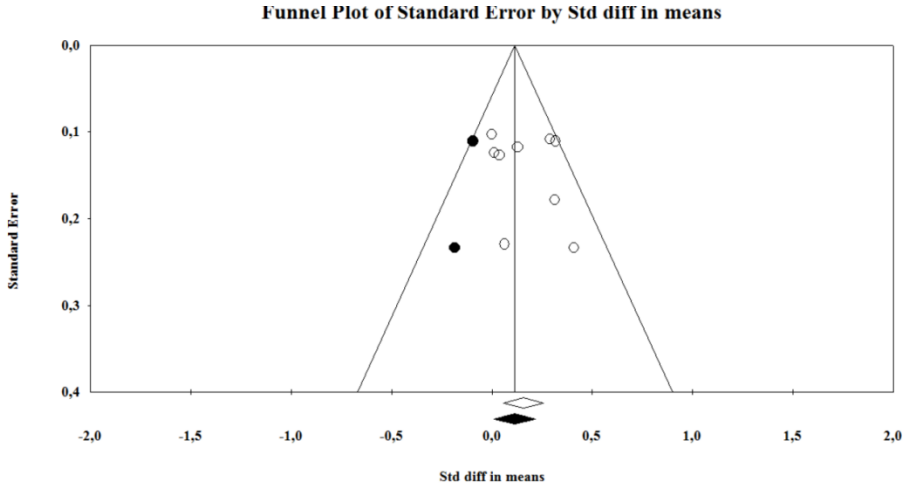

Figure 5. Funnel Plot for Educational Background

In figure 5, it is seen that researches cumulated in the middle and the upper and also distributed on the left and the right side of the line symmetrically. Orwin's Safe N was calculated. As a result, no more researches were included.

Table 3 reveals that effect size estimated for fixed-effects model is 0.154 while it is 0.156 for random effects model. Female have positive effect size on educational background than male according to the results of both models. The lowest limit of confidence interval calculated for fixed-effect model is 0.069 while the highest limit 0.239. However, the lowest limit of confidence interval calculated for random-effect model is 0.057 while the highest limit 0.255.

Table 3. Meta-Analysis Findings for Gender Effect on Educational Background

Model used	Number of Studies	ES	Lower Limit of the Confidence Interval	Upper Limit of the Confidence Interval	Z-value	p-value	Q-value	p-value	I^2	τ^2
Fixed-effect	9	0,154	0,069	0,239	3,542	0,000	10,288	0,245	22,24	0,00

Q statistic was found to be (10.288). This result suggests that each research included in this study have the same mean scores. As an indicator to the heterogeneity, I^2 was found to be 22.242 and τ^2 was as 0.005 calculated as 0. Figure 6 shows the forest plot regarding effect size values of each research.

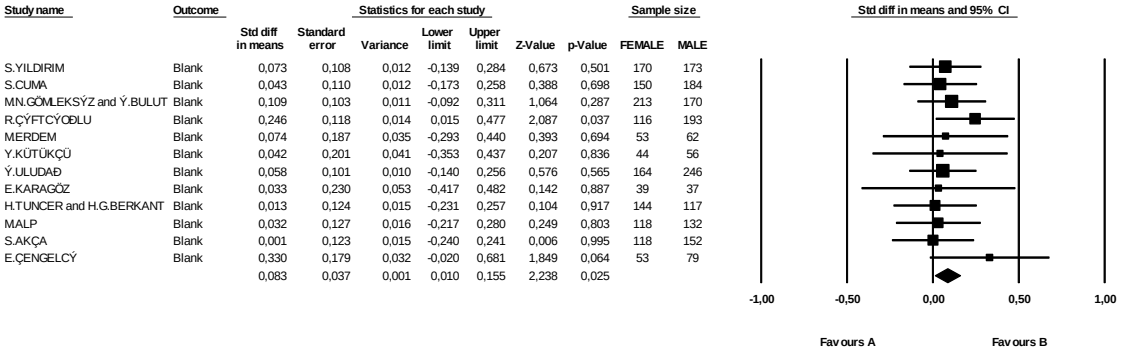

Figure 6. Forest Plot regarding Gender Effect on educational Background

When the effect sizes of the researches included were investigated, the lowest effect size value was observed as 0.00 while the highest value 0.409. All 9 researches have positive effect. This positive effects reveal that female have a postive effect than male in terms of educational background.

3.4 Gender Effect on Measurement and Evaluation

In order to determine if gender has an effect on measurement and evaluation element of the curriculum, publication bias was checked first. Funnel plot concerning this issue was shown in figure 6.

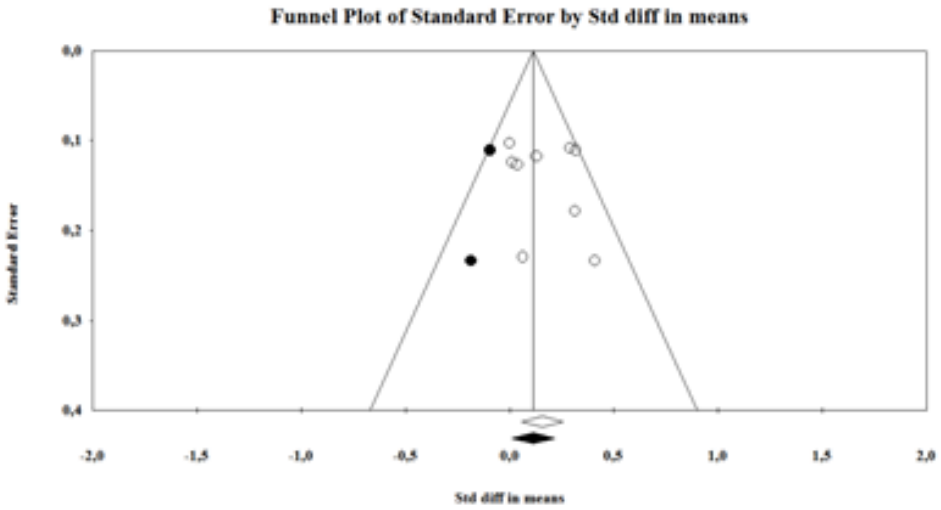

Figure 7. Funnel Plot for Measurement and Evaluation

In figure 6, it is seen that researches cumulated in the middle and the upper. Yet, two researches were seen to locate themselves to the right side of the figure. No more researches were included according to the result of Orwin's safe N.

Table 4. Meta-Analysis Findings for Gender Effect on Assessment and Evaluation

Model used	Number of Studies	ES	Lower Limit of the Confidence Interval	Upper Limit of the Confidence Interval	Z-value	p-value	Q-value	p-value	I^2	τ^2
Fixed-effect	9	0.137	0.061	0.214	3.504	0.000	10.744	0.378	6.923	0.001

Table 4 reveals that effect size estimated for fixed-effects model is 0.137 while it is 0.139 for random effects model. Female have positive effect size on measurement and evaluation than male according to the results of both models. The lowest limit of confidence interval calculated for fixed-effect model is 0.061 while the highest limit 0.214. However, the lowest limit of confidence interval calculated for random-effects model is 0.059 while the highest limit 0.220.

Q statistic was found to be (10.774). This result suggests that each research included in this study have the same mean scores. As an indicator to the heterogeneity, I^2 was found to be 6.923 and τ^2 was as 0.001. calculated as 0. Figure 8 shows the forest plot regarding effect size values of each research.

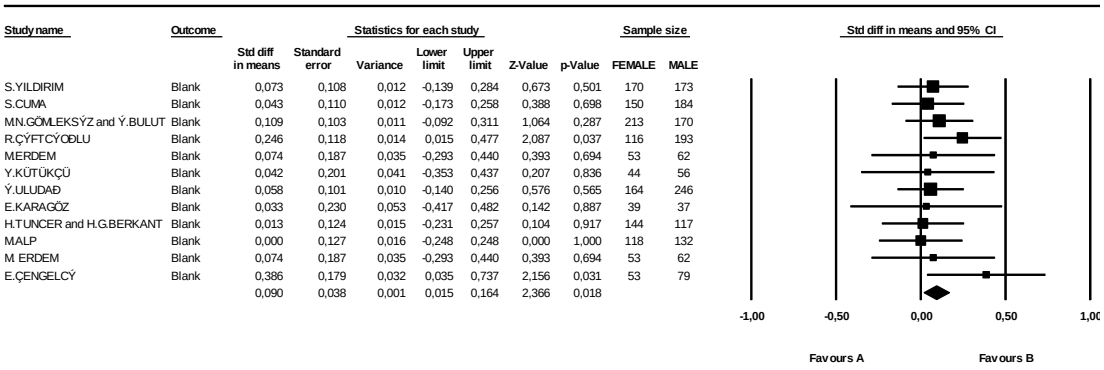

Figure 8. Forest Plot of Gender Effect on Measurement and Evaluation

When the effect sizes of the researches included were investigated, the lowest effect size value was observed as 0.00 while the highest value 0.574. All 9 researches have positive effect. This positive effects reveal that female have a postive effect than male in terms of measurement and evaluation.

4. Discussion and Conclusion

In this chapter, research findings were revealed, assessed and interpreted. Articles and thesis were presented in accordance with the criteria determined in the study. Those research papers were selected from the scientific papers published between 2005-2015.

Studies with mean scores, standard deviation and sample size were included in this study. Standardized mean difference

was used as size effect. Research question was constructed as to investigate gender effect on elementary mathematics and science and techonology teachers' opinions regarding curriculum elements which are educational aim, content, educational background and evaluation.

In order to answer the first question, 15 studies which were focused on gender effect on educational aims were included to this study. According to the results of the analysis, homogenity value Q was calculated as 5,486 (p value =0,978). As there is not statistical significant difference, combined effect size was found to be ES= 0,122 , %95 CI= 0,055-0,190 in fixed effect and random effect models. Effect size values obtained from each study were observed to be positive meaning that combined effect size value has a small effect. In conclusion, mistresses has a smaller effect than masters in therms of educational aims.

As an answer to the second question, 13 studies which were focused on gender effect on content were included to this study. According to the results of the analysis, homogenity value Q was calculated as 5,856 (p value=0,833). As there is not statistical significant difference, combined effect size was found to be ES= 0,090, %95 CI= 0,015-0,0164 in both fixed effect and random effect models. Effect size values obtained from each study were observed to be positive meaning that combined effect size value has a small effect. In conclusion, mistresses has a smaller effect than masters in terms of content.

In order to examine the third question, 9 studied which were focused on gender effect on educational background were included to this study. While effect size for fixed-effect model was 0,154, predicted effect size value for random effect model was calculated as 0,156. These results reveal that mistresses have a more positive effect size than masters. Confidence interval lowest and highest limits for fixed effect model was found respectively as 0,069 and 0,239. Q value was calculated as (10,288). This value states that each study has the same mean scores. I^2 and τ^2 values were found respectively 22,242 and 0,005. This result means that mistresses have a smaller effect than masters regarding educational background.

In order to examine the gender effect on measurement and evaluation, 9 studies which were appropriate for the inclusion criteria were included to meta-analysis. Effect size for fixed effect model was 0,137 while it was 0,139 for random effect model. Mistresses have a more positive effect size than masters according to the results of both models.

Confidence interval lowest and highest limits for fixed effect model was found respectively as 0,061 and 0,214 while the lowest and the highest limits for random effect model was found respectively to be 0,059 and 0,220. Q value was calculated as (10,744). This value tells that each study has the same mean scores.I^2value was calculated as 6,923 andτ^2 values was calculated as 0,001. This result means that mistresses have a smaller effect than masters regarding measurement and evaluation.

5. Suggestions

Meta-analysis which aims to combine data is observed to be ignored in Turkey literature although it has a substantial importance in education field. No articles using meta-analysis as a method from curriculum evaluation in education field was found. This study is considered to be important as it is the very first research conducted regarding curriculum evaluation in education field.

In this study, gender effect on elementary school mathematics and science and technology teachers' opinions regarding curriculum elements which are educational aim, content, educational background and evaluation was examined. Future studies about curriculum of different subjects might be conducted to make a generalisation for Turkey in order to eliminate the deficiency on the field. Furthermore, it might also be useful as it might lead a path for curriculum evaluators.

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