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The Effect of Different Critical Thinking Teaching Approaches on Critical Thinking Skills: A Meta-Analysis Study

Farklı Eleştirel Düşünme Öğretim Yaklaşımlarının Eleştirel Düşünme Becerisine Etkisi: Bir Meta Analiz Çalışması

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Abstract

Critical thinking (CT) which is self-regulatory thinking process includes some skills like interpretation, analysis, evaluation, inference and evidence questioning. There are skill-based, content-based and mix CT teaching approaches in literature. It is important to find out how effective these approaches are on CT skills rather than whether they are effective on CT. So this study aimed to determine to what extent the content-based and skill-based teaching of CT is effective in improving the CT skills. 21 results of 17 research studies were included in the meta-analysis. The content-based teaching of CT is strongly effective in improving students' CT skills. This effect level does not differ significantly by whether the sample group is gifted or normal students and by educational level of sample groups. Also, the skill-based teaching of CT is strongly effective in improving students' CT skills. Besides, the effect size of the studies which applied the skill-based teaching of CT is higher than the effect size of the studies which applied the content-based teaching of CT. However, there is no significant difference between these two approaches in terms of improving CT skills. So skill based and content based critical thinking teaching approaches can be used for all students from different education levels to improve critical thinking skills.

Keywords: Critical thinking teaching, critical thinking teaching approaches, meta-analysis, skill based critical thinking teaching approach, content based critical thinking teaching approach

Cited:

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Öz

Öz düzenleyici bir düşünme süreci olan eleştirel düşünme yorumlama, analiz, değerlendirme, çıkarımda bulunma ve kanıtları sorgulama gibi becerileri içinde barındırır. Alanyazında beceri temelli, içerik temelli ve karma yaklaşım olmak üzere üç farklı temel eleştirel düşünme öğretim yaklaşımı bulunmaktadır. Kullanılan yaklaşımın eleştirel düşünme becerisi üzerinde etkili olup olmadığı yerine bu yaklaşımın eleştirel düşünme becerisi üzerinde ne derece etkili olduğunun öğrenilmesi daha önemlidir. Dolayısıyla, bu çalışmada içerik temelli ve beceri temelli eleştirel düşünme öğretim yaklaşımlarının eleştirel düşünme becerisini geliştirmede ne derece etkili olduğunun belirlenmesi amaçlanmıştır. 17 araştırmaya ait 21 sonuç meta analize dahil edilmiştir. İçerik temelli eleştirel düşünme öğretim yaklaşımı öğrencilerin eleştirel düşünme becerisini geliştirmede güçlü düzeyde etkilidir. Bu etki düzeyi örneklem grubunun üstün yetenekli ya da normal yetenekli olmasına ve örneklem grubunun öğretim seviyesine göre anlamlı bir şekilde farklılaşmamaktadır. Ayrıca beceri temelli eleştirel düşünme öğretim yaklaşımı öğrencilerin eleştirel düşünme becerisini geliştirmede güçlü düzeyde etkilidir. Buna ek olarak, beceri temelli eleştirel düşünme öğretimi yapılan çalışmaların etki büyüklüğü, içerik temelli eleştirel düşünme öğretimi yapılan çalışmaların etki büyüklüğünden yüksektir. Ancak bu iki yaklaşım arasında, eleştirel düşünme becerisini geliştirme açısından anlamlı bir fark yoktur. Dolayısıyla içerik temelli ve beceri temelli eleştirel düşünme öğretim yaklaşımı bütün öğretim seviyelerinde eleştirel düşünme becerisinin geliştirilmesinde kullanılabilir.

Anahtar sözcükler: Eleştirel düşünme öğretimi, eleştirel düşünme öğretim yaklaşımları, meta-analiz, beceri temelli eleştirel düşünme öğretimi, içerik temelli eleştirel düşünme öğretimi

Atıf:

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Introduction

Critical thinking (CT), which dates back to Socrates (Vandenberg, 2009), is still a subject of considerable interest to cognitive theorists and educators today (Akınoğlu, 2001; Ay and Akgöl, 2008). CT is defined as a conscious and self-regulatory thinking process that includes skills such as interpretation, analysis, evaluation, inference and evidence questioning (Facione, 1990). According to Watson-Glaser (2010), the CT process involves the ability to recognize the existence of a problem, to question the source of information and to question the accuracy of the evidence, and to evaluate different data and evidence. In other words, the source of the CT process can be regarded as achieving results with observations and knowledge that have been questioned and tested for accuracy (Paul, 1992). Therefore, with the CT, individual acquires the skill of thinking properly and having the right information about their environment (Schafersman, 1991). Because CT skill is a reflective and logical thinking process (Ennis, 1985) in which the individual seeks solid evidence when deciding how to act or what to believe (Schafersman, 1991; Meltzoff and Cooper, 2018). As a result of this act of thinking, one also takes control of the structures in their own thinking process and develops them according to the intellectual standards they set themselves (Scriven and Paul, 2004; Paul and Elder, 2019).

Some different approaches have been adopted by different researchers about the teaching of CT (Beyer, 1987; Resnick, 1987; Lipman, 1988; Kenyon and Guillaume, 2014). Prior to previous studies in literature, it seems that three basic approaches are widely used in the teaching of CT skills. These approaches are content-based teaching of CT, skill-based teaching of CT, and mixed teaching of CT.

According to the first of these approaches, CT skills are taught by integrating them into the content of a course. According to McPeck (2016), it is meaningless to teach CT skills independently of a context as the individual thinks on content or subject when using thinking skills. There is no set of CT skills that can fit all contents or topics. Therefore, the skills in question need to be integrated into educational programs and taught in all courses (Resnick, 1987). In this way, students will be able to use their skills in real life and in different courses.

The skill-based approach in the teaching of CT argues that CT skills should be taught as a different course independent of the content of the courses in the curriculum (Sternberg, 1985). According to Ennis (1991) who identified the 12 dimensions of CT, all of these dimensions can be taught, and can be acquired by students. Therefore, there is no problem in the teaching of these skills in a separate course on a skill basis (Ennis, 1991). When CT skills are taught on the content-based basis within a course, the focus is on the course content and CT skills are ignored (Lipman, 1988). Hence, the skill-based teaching approach, which allows to avoid focusing on the subjects in the course content and repeating these subjects all the time, is more effective in bringing CT skills and using these skills in other courses (Ennis, 1991; Beyer, 1991). In the mixed teaching approach, the teaching of CT starts on the skill basis, and then, continues on the content basis (Perkins and Salomon, 1989). Therefore, advocates of each approach mention different advantages or disadvantages of CT. With this information at hand, one cannot be sure which approach creates more effective results in the teaching of CT.

As for the studies investigating the effect of the content-based and skills-based teaching approaches on CT skills in Turkey, the question which approach is more effective in promoting

the CT skills cannot be answered because teaching approaches of CT used in all of these studies conducted independently by different researchers and at different times significantly enhanced the CT skill. However, it is difficult to identify to what extent the approach is effective in improving CT skills. It is more important to find out how effective this approach is on CT skills rather than whether it is effective on CT. Meta-analysis studies that combine the results of similar studies conducted on a certain subject by different people are of importance (McMillan and Schumacher, 2001) as these studies allow a consistent interpretation of the information accumulated in a specific area (Akgöz, Ercan and Kan, 2004). The meta-analysis method aims to bring together the results of the studies in the literature in a consistent and coherent manner with the statistical methods (Cohen, 1988; Chambers, 2004), to discuss the results of these quantitative studies in a holistic manner (Creswell, 2014) and to achieve more extensive and generalizable results, gaining an upper point of view (Erkuş, 2009).

Although there are several studies on CT in the literature in Turkey, a meta-analysis study that is able to answer this question is yet to be carried out. In the international literature, however, there are studies investigating the experimental studies which have been conducted on CT skills in a systematic way (Abrami et al., 2008; Behar-Horenstein and Niu, 2011; Abrami et al., 2015). In this context, the question "How effective are the content-based and skill-based teaching approaches of CT in improving CT skills?" presents the questions of this research to fill this gap. Thus, a broader perspective will be taken to see experimental studies in Turkey using these teaching approaches, and a general consideration will be achieved on which of the approaches are more effective in Turkey. It is anticipated that such consideration will guide teachers, academics and other researchers in their own work.

To this end, answers to the following questions were sought for:

1. At what level does the content-based teaching approach of CT affect CT skills?
    a. Does this level of effect vary by different variables (whether the sample is normal or gifted students and sample's educational level)?
2. At what level does the skill-based teaching approach of CT affect CT skills?
3. Is there any difference between the effect levels of the content-based and skill-based teaching approaches of CT on CT skills?

Research Model

Meta-analysis method was used in this study which aimed to determine the effects of content-based and skill-based teaching approaches of CT on CT skills. Meta-analysis is a method that helps gather, combine findings from similar studies conducted on a given subject at different places and times and calculate a shared effect size through statistical methods (Cohen, Manion & Morrison, 2007). Thus, a common conclusion can be drawn about these studies, and it becomes possible to make a general interpretation (Hedges & Olkin, 1985). The steps followed in this study can be listed as follows:

1. Identify the problem
2. Review the literature for the collection of studies
3. Coding of the studies
4. Data analysis and interpretation

The problem of this study is to determine the effect size of the content-based and skill-based approaches used in the teaching of CT on CT skills.

Collection of Studies

Inclusion criteria were determined to decide whether to include studies collected in the literature review in the first place. Then, the suitability of the studies to the inclusion criteria was examined by two different people, and the studies that met these criteria were included in the analysis.

The criteria used for the inclusion of the studies that were found in the literature review can be listed as follows:

1. Studies conducted between 2005 and 2019 in Turkey,
2. Studies written in Turkish or English,
3. Studies that are postgraduate theses or papers published in peer-reviewed scientific journals,
4. Studies conducted with experimental method,
5. Studies that implemented the content-based or skill-based approaches of CT in the experimental group and traditional teaching approach in the control group.
6. Studies that used instruments measuring the CT performance. In other words, studies using data collection instruments developed to determine the CT disposition were not included in the study.
7. Studies that clearly specify the statistical data required to calculate the effect size.

The studies included in the research in consideration of the abovementioned criteria are the postgraduate theses and papers conducted on the teaching of CT in Turkey between 2006 and 2018. According to Wells and Littel (2009), one of the criticisms against meta-analysis studies is about the quality of primary studies included in the analysis. Therefore, only the postgraduate theses and the papers published in peer-reviewed scientific journals were included in this study and the papers on the teaching of CT presented in scientific activities such as congresses or symposiums were not included to keep clear of this criticism and mitigate the quality problem.

To access the theses on the subject, a search was performed in Higher Education Council (YÖK) national thesis database with the Turkish keywords of "*eleştirel düşünme öğretimi*", "*eleştirel düşünme*", "*eleştirel düşünme becerisi*", "*içerik temelli eleştirel düşünme öğretimi*", "*beceri temelli eleştirel düşünme öğretimi*" and the English keywords of "CT teaching", "CT", "improving CT skills", "teaching CT" between 20.02.2019 and 01.03.2019. 103 theses were accessed in the search. The oldest thesis among them was written in 2005 and the latest in 2018. The theses were reviewed in terms of inclusion criteria. Even if the terms of skill-based or content-based teaching of CT are not directly available in the title or content of the theses, the studies that were decided to have used content-based or skill-based teaching of CT after reading the experimental procedures and the stages of the CT teaching were included in the study. It was found after reviewing the theses that 15 theses were fit for the research purpose and the inclusion criteria. Thus, 15 theses were accessed in the literature review and included in the meta-analysis. Since 2 experimental groups were formed in each three of the

theses, it was possible to access the results of 18 experimental studies which were conducted with 18 experimental and 18 control groups.

Another search was made with the abovementioned keywords to access papers published on the subject on the databases of ULAKBİM, Google Scholar, EBSCOhost, Web of Science, and ERIC between 20.02.2019 and 01.13.2019, and those from Turkey were downloaded on the computer. The downloaded papers were evaluated by the inclusion criteria, and it was seen that 5 papers met the criteria. In case the postgraduate theses might have been published separately, the papers and theses were compared, and it was found that the case applied to 3 papers. Therefore, this study did not include these papers but their thesis versions. Consequently, 2 papers were found in the literature review and included in the meta-analysis. However, since one of the papers has 2 experimental groups and 1 control group, the findings of 2 experimental studies could be derived from this study, and in the end, the findings of 3 experimental studies in total were included in the study.

Then, the bibliography sections of the theses and papers were reviewed in detail to access other studies on the subject. Yet, no study meeting the inclusion criteria was observed with this method. As a result, there are 309 samples in total in the experimental groups in which the content-based teaching approach was applied, 204 samples in total in the experimental groups in which the skill-based teaching approach was applied, and 473 samples in the control groups in 15 postgraduate theses and 2 papers that meet the inclusion criteria and could be accessed.

Coding of Studies

A form was developed by the researcher to code the studies included in the meta-analysis. The coding form involves information such as name of study, its publication year, type and author(s), which teaching approach of CT it used, instrument for measuring the CT skill, field of study, its experimental and control groups; characteristics and numbers of the sample, and data required for the calculation of effect size. The content validity of the coding form was achieved through expert opinion, and small changes were made to the form as a result of the feedbacks.

The studies included in the analysis were coded with the coding form by the researcher and by another person who is doing doctorate in educational sciences to increase the reliability of the study and minimize possible errors. Using the formula (Number of Agreements/[Number of Agreements+ Number of Disagreements]) proposed by Miles and Huberman (1994), the coefficient of concordance among the codes were calculated and found 0.98. According to Miles & Huberman (1994), the coefficient of concordance above 0.70 indicates a reliable study. So it can be concluded there is a high concordance between the two coders. The characteristics of the studies included in the meta-analysis can be seen in Table 1.

Table 1. Characteristics of the Studies Included in the Meta-Analysis

Name of Study	Author	Year	Type of Study
The effect of teaching with the mathematics activity based on Purdue model on the achievement and critical thinking skills of gifted students	Altıntaş, E.	2009	Postgraduate Thesis
The effect of differentiated social studies instruction on gifted students' academic achievement, attitudes, critical thinking and creativity	Atalay, Z. Ö.	2014	Doctoral Thesis
The effect of content and skill based critical thinking teaching on prospective teachers' disposition and level in critical thinking	Aybek, B.	2006	Doctoral Thesis
An investigation of the effect of Waldmann model based text education on 8th. grade students' reading comprehension, critical thinking and creative thinking skills	Balta, E. E.	2011	Doctoral Thesis
The effect of critical thinking curriculum on students' critical thinking skills and self-evaluation levels	Eğmir, E. & Ocak, G.	2017	Paper
The effect of project based learning in social sciences on gifted students' achievement, critical thinking and creativity	Eşsizoğlu, G.	2013	Postgraduate Thesis
Teaching skills through the use of short stories	Güneşdoğdu, M.	2015	Postgraduate Thesis
Achievements of students of above average and average intelligence in Turkish language classes focusing on critical thinking skills, and the effect of those classes on their critical thinking levels and attitudes	İşlekeller, A.	2008	Postgraduate Thesis
The effect of differentiated foreign language instruction on gifted students' achievement, critical thinking and creativity	Kaplan Sayı, A.	2013	Doctoral Thesis
The effects of the social studies course, organized for critical reading, on students? critical thinking skills	Özensoy, A. U.	2011	Doctoral Thesis
The effect of content-based critical thinking teaching on the critical thinking tendency and level of teacher candidates	Schreglmann, S.	2011	Postgraduate Thesis
The effect of argumentation based science learning approach on academic success, metacognition and critical thinking skills of gifted students	Şahin, E.	2016	Doctoral Thesis
The effects of thinking skills education on the critical thinking and problem solving skills of preschool teacher candidates	Tok, E. & Sevinç, M.	2010	Paper
The effects of differentiated curriculum with blended learning method on gifted students' academic achievement, critical thinking abilities and creative	Umar, Ç. N.	2014	Doctoral Thesis
The effect of digital stories based social studies courses on students' achievement, locus of control and critical thinking skills	Ünlü, B.	2018	Postgraduate Thesis
Effects of brain based science teaching on gifted students' achievement, critical thinking, creativity and attitudes	Yaman, Y.	2014	Doctoral Thesis
The effect of science education based on critical thinking on learning products	Yıldırım, H. İ.	2009	Doctoral Thesis

According to Table 1, most of the studies included in the meta-analysis (n:9) are doctoral theses. The doctoral theses are followed by postgraduate theses (n:6) and doctoral

theses (n:2), respectively. In addition, the studies were most conducted in 2014 (n:3), 2011 (n:3), 2013 (n:2) and 2009 (n:2) respectively.

Data Analysis and Interpretation

In this study aiming to determine at what level the content-based and skill-based teaching approaches of CT affect CT skills, these teaching approaches of CT were set as independent variables while CT skills was decided to be the dependent variable.

The data obtained on the studies with the coding form were transferred to the CMA software. The arithmetic mean, standard deviation and sample number of 21 experimental studies were utilized for meta-analysis. The coding form used for transferring the data to the software prevented incorrect data entries.

In this study, the p value was checked to decide whether there was heterogeneity in the first place, then the Q value was checked according to the value in the X^2 table, and finally the I^2 value was checked.

Hedge's *g* coefficient was utilized in the effect size calculations, and the confidence level was determined to be 95% in all calculations in the study. The classification introduced by Cohen, Manion & Morrison (2007) was used for the interpretation of the effect size. The classification of effect sizes is as follows:

Table 2. Cohen, Manion & Morrison's (2007) Effect Size Classification

$0 \leq ESV \leq 0.20$	Weak
$0.21 \leq ESV \leq 0.50$	Modest
$0.51 \leq ESV \leq 1.00$	Moderate
$1.01 \leq ESV$	Strong
ESV = Effect size value	

The criterion values shown in Table 2 were used to interpret the effect size achieved in the study. The funnel plot was used to determine whether there was publication bias. Also, Rosenthal's Fail-Safe N test was used to support the findings of funnel plot.

Checking Studies Which Applied Content-Based Teaching of CT for Publication Bias

It was tested before calculating the effect sizes whether there was publication bias. The results of funnel plot which allowed us to comment on the presence/absence of publication bias are as follows:

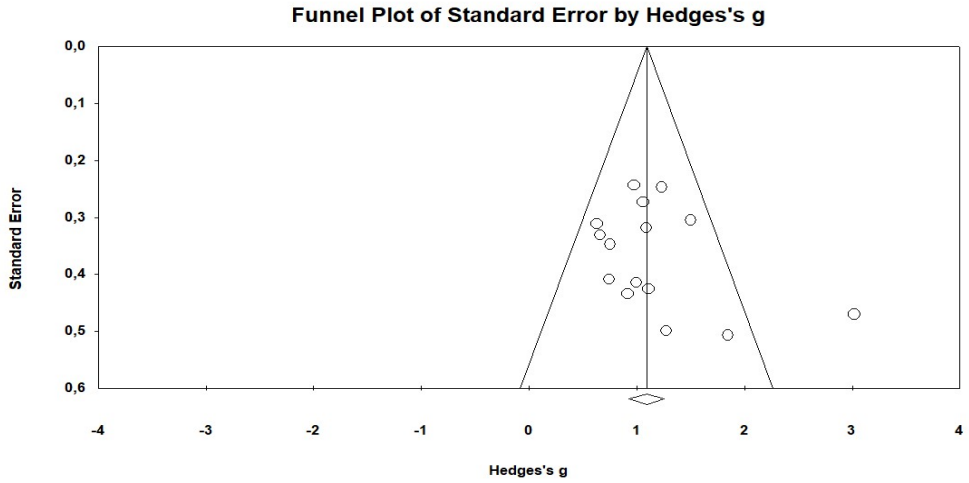

Figure 1. Funnel plot of effect sizes

To be able to conclude that there is no publication bias, effect sizes of studies need to be distributed symmetrically around the general effect size in the funnel plot (Borenstein et al., 2009). Hence, according to the funnel plot in Figure 1, the effect sizes of 16 studies included in the research are symmetrically distributed around the general effect size except one study. Therefore, it is possible to conclude that there is no publication bias. In addition, Rosenthal's Fail-Safe N test was performed for reinforcing the finding achieved in the funnel plot. The findings are presented below:

Table 3. Findings of Rosenthal's Fail-Safe N Test in Regard to Whether There Is Publication Bias among Studies That Applied Content-based Teaching of CT

Z-value for Reviewed Studies	12.71129
p-value for Reviewed Studies	0.00000*
Alpha	0.05000
Direction	2
Z-value for Alpha	1.95996
Number of analyzed studies	16
Fail-safe Number	657

*p<0.05

Table 3 indicates that the findings achieved in Rosenthal's Fail-Safe N test coincide with the funnel plot findings. It was concluded in Rosenthal's Fail-Safe N test that 657 studies with an effect size of zero need to be included further in the analysis for the meta-analysis results achieved in this study to lose their significance. It can be inferred from this number which is much higher than the number of reviewed studies that there is no publication bias (Rosenthal, 1979). Besides that, Begg and Mazumdar rank correlation test is another way to test presence/absence of publication bias. As a result of Begg and Mazumdar rank correlation test, p value should be over 0.05 to say there is no publication bias (Begg & Mazumdar, 1994). So it can be said that there is no publication bias among studies that applied content-based teaching of CT (Tau b=0.27; p >0.05). Thus, the findings achieved both in the funnel plot, Rosenthal's Fail-Safe test and Begg and Mazumdar rank correlation test show that there is no publication bias in this study.

Checking Studies Which Applied Content-Based Teaching of CT for Heterogeneity

Heterogeneity test is important for a meta-analysis because the statistical model to be applied in meta-analysis is decided according to the result of this test (Huedo-Medina et al., 2006). A heterogeneity test was accordingly performed to decide which statistical model would be used in this study. The findings of the heterogeneity test are given below:

Table 4. Findings on the Heterogeneity Test of Studies Which Used the Content-based Teaching of CT According to the Fixed Effects Model

General Effect Size (g)	Degree of Freedom (df)	Heterogeneity Value (Q)	Chi-Square Table Value (X^2)	I^2	Mean Confidence Level for Effect Size	
					Lower Limit	Upper Limit
1.090	15	28.072	24.996	46.565	0.922	1.258

I^2 = Actual heterogeneity rate of total variance in the observed effect

According to Table 4, Q value is 28.072. This value is above the critical value of 24.996 prescribed for 15 degree of freedom and also at 95% significance level in the X^2 table. Then it is obvious that there is heterogeneity among the studies according to the Q value achieved. Nevertheless, I^2 value that is not influenced by the number of studies and can measure heterogeneity more accurately (Petticrew & Roberts, 2006) was also calculated to support the Q statistic which is likely to fall weak in identifying the heterogeneity in case of low number of studies subjected to the meta-analysis (Huedo-Medina et al., 2006). The table shows that the I^2 value is 46.5%. Cooper, Hedges and Valentine (2009) state that I^2 being 25% refers to low, being 50% to moderate, and being 75% to high heterogeneity. Hence, this value indicates that there is moderate heterogeneity among the studies. Moreover, the p value is below 0.05 ($p=0.021$). As a result, all values obtained ($Q=28.072$, $p>0.05$, $I^2=45.565$) show that there is heterogeneity among the studies and the random effects model can be used to calculate the effect size.

Checking Studies Which Applied Skill-Based Teaching of CT for Publication Bias

The results of funnel plot which allowed us to comment on the presence/absence of publication bias are as follows:

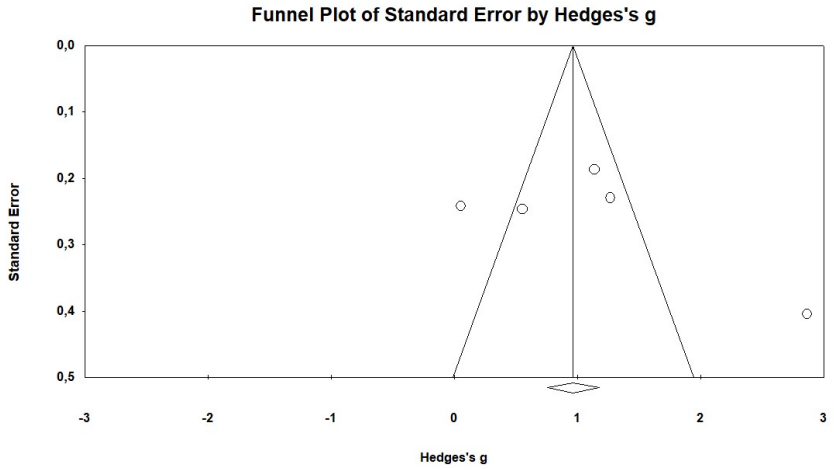

Figure 2. Funnel plot of effect sizes

According to the funnel plot in Figure 2, effect sizes of 5 studies included in the research are symmetrically scattered around the general effect size except in two studies. It can be therefore concluded that there is no publication bias. Rosenthal's Fail-Safe N test was utilized for reinforcing the finding achieved in the funnel plot. The findings are presented below:

Table 5. Findings of Rosenthal's Fail-Safe N Test in Regard to Whether There is Publication Bias among Studies That Applied Skill-based Teaching of CT

Z-value for Reviewed Studies	9.46820
p-value for Reviewed Studies	0.00000*
Alpha	0.05000
Direction	2
Z-value for Alpha	1.95996
Number of analyzed studies	5
Fail-safe Number	112

*p<0.05

Table 5 shows that the findings achieved in Rosenthal's Fail-Safe N test in Table 5 coincide with the funnel plot findings. 112 studies with an effect size of zero need to be conducted further for the meta-analysis results obtained from the study on the skill-based teaching of CT to lose their significance. Also the result of Begg and Mazumdar rank correlation test supports that there is no publication bias among studies that applied skill-based teaching of CT (Tau b =0.20; p >0.05). Therefore, the findings achieved both in the funnel plot, Rosenthal's Fail-Safe test and Begg and Mazumdar rank correlation test show that there is no publication bias in this study.

Checking Studies Which Applies Skill-Based Teaching of CT for Heterogeneity

A heterogeneity test was performed first to decide which statistical model to use, and the findings are given in Table 6.

Table 6. Findings on the Heterogeneity Test of Studies Which Used the Skill-based Teaching of CT According to the Fixed Effects Model

General Effect Size (g)	Degree of Freedom (df)	Heterogeneity Value (Q)	Chi-Square Table Value (X^2)	I^2	Mean Confidence Level for Effect Size	
					Lower Limit	Upper Limit
0.964	4	41.721	9.488	90.412	0.754	1.174

I^2 = Actual heterogeneity rate of total variance in the observed effect

According to Table 6, Q value is 41.721. This value is above the critical value of 9.488 prescribed for 4 degree of freedom and at 95% significance level in the X^2 table. So, it is clear that there is heterogeneity among the studies according to the Q value achieved. The table also shows that the I^2 value is 90.412%. This value accordingly indicates that there is high heterogeneity among the studies. Moreover, the p value is below 0.05 (p=0.00). As a result, all values obtained (Q=41.721, p>0.05, I^2=90.412) show that there is heterogeneity among the studies and the random effects model can be used to calculate the effect size.

Findings

Findings on the Effect Size of Content-Based Teaching of CT on CT Skills

Since heterogeneity was identified among the studies included in the meta-analysis, the effect sizes of the studies were combined using the random effects model. The general effect size obtained with the random effects model can be seen in the table below:

Table 7. Findings on the Heterogeneity Test of Studies which Used the Content-based Teaching of CT According to the Random Effects Model

General Effect Size (g)	N	Standard Error (SE)	Variance	Z	P	Mean Confidence Level for Effect Size	
						Lower Limit	Upper Limit
1.111	16	0.121	0.015	9.198	0.000*	0.875	1.348

*p<0.05

Table 7 shows that according to the random effects model, the general effect size of the content-based teaching of CT on CT skill is 1.111 with an error of 0.121. This is a strong effect in accordance with the classification of Cohen, Manion & Morrison (2007). Likewise, lower limit of the effect size calculated with the random effects model is 0.875, and its upper limit is 1.348 within the confidence range of 95%. The values of effect size can be assumed to be statistically significant (Z=9.198; p=0.00). In view of this finding, it can be concluded that the content-based teaching of CT strongly affects CT skills. In other words, the content-based teaching approach of CT is more effective positively and strongly on students' CT skills.

The studies were divided into two different groups to determine whether effect size differs by whether the sample group is gifted or normal students. The results of the analysis with the two groups are given in Table 8.

Table 8. Effect Size by Whether the Sample Group is Gifted or Normal Students and Findings of the Heterogeneity Test

Model			95% Confidence Range		Degree of Freedom (df)	Heterogeneity Test	
Random Effects Model	N	Hedge's g	Lower Limit	Upper Limit		Q value	p value
Gifted	8	1.247	0.759	1.735	1	0.606	0.436
Normal	8	1.039	0.828	1.250			

Table 8 shows that all effect sizes are positive, and the studies conducted on gifted students have a higher effect size (g=1.247) than the studies conducted on normal students (g=1.039). The effect sizes calculated for both study groups are strong. Furthermore, the Q value was found 0.606 in the heterogeneity test performed to determine whether the effect sizes differ by sample characteristics. This value is below the critical value of 3.841 which is prescribed for 1 degree of freedom and at significance level of 95% in the X^2 table. The achieved p value is also above 0.05 (p=0.43). It can be therefore argued that there is no significant difference between the effect sizes of the studies investigating the effect of content-based teaching of CT on CT skills with sample groups of gifted students and normal students

(Q=0.606; p=0.436). However, one can argue that the studies conducted with gifted students have a higher effect size than the studies conducted with normal students.

The studies were divided into four different groups of primary, secondary, high schools and university to determine whether the effect size differs by educational level. The results of the analysis on these four groups are shown in Table 9.

Table 9. Effect Size by Educational Level of Sample Groups and Findings of the Heterogeneity Test

Model			95% Confidence Range		Degree of Freedom (df)	Heterogeneity Test	
Random Effects Model	N	Hedge's g	Lower Limit	Upper Limit		Q value	p value
Primary School	2	1.172	-0.012	2.356	3	4.574	0.206
Secondary School	10	1.151	0.817	1.485			
High School	2	0.704	0.235	1.173			
University	2	1.341	0.965	1.716			

Table 9 shows that all effect sizes are positive and the studies conducted on university students have the highest effect size at 1.341. University students are followed by primary school students (g=1.172), secondary school students (g=1.151) and high school students (g= 0.704), respectively. The calculated effect size values are strong for all groups except high school students. The effect size calculated for high school students is moderate. In this case, it can be concluded that the content-based teaching of CT improves the CT skills of primary and secondary school students and university students at a strong level while improving high school students' CT skills at a moderate level. The Q value was found 4.574 in the heterogeneity test to determine whether the effect sizes differ by educational level of sample groups. This value is below the critical value of 7.185 which is prescribed for 3 degree of freedom and at significance level of 95% in the X^2 table. The achieved p value is also above 0.05 (p=0.20). It can be therefore said that the distribution is homogeneous (Q=4.574; p=0.206). In other words, educational level of sample groups is not a factor that changes the calculated effect size.

Findings on the Effect Size of Skill-Based Teaching of CT on CT Skills

Since heterogeneity was identified among the skill-based studies included in the meta-analysis, the effect sizes of the studies were combined using the random effects model. The general effect size obtained with the random effects model is given in Table 10.

Table 10. Findings on the Effect Size of Studies Which Used the Skill-based Teaching of CT According to the Random Effects Model

General Effect Size (g)	N	Standard Error (SE)	Variance	Z	P	Mean Confidence Level for Effect Size	
						Lower Limit	Upper Limit
1.126	5	0.356	0.127	3.162	0.002*	0.428	1.824

*p<0.05

As seen in Table 10, the general effect size of the skill-based teaching of CT on CT skill is 1.126 with an error of 0.356 according to the random effects model. This value refers to strong effect. Likewise, lower limit of the effect size calculated with the random effects model

is 0.428, and its upper limit is 1.824 within the confidence range of 95%. The values of effect size can be assumed to be statistically significant (Z=3.162; p=0.002). It can be inferred from this finding that the skill-based teaching of CT strongly affects CT skills. In other words, the skill-based teaching approach of CT is more effective strongly on students' CT skills compared to traditional teaching approaches.

Table 11 presents the analysis results of the two groups formed to determine whether there is a difference between the effect sizes of the content-based and skill-based teaching approaches of CT on CT skills.

Table 11. Effect Size by the Teaching Approach of CT and Findings of the Heterogeneity Test

Model			95% Confidence Range		Degree of Freedom (df)	Heterogeneity Test	
Random Effects Model	N	Hedge's g	Lower Limit	Upper Limit		Q value	p value
Content-Based Teaching of CT	16	1.111	0.875	1.348	1	0.842	0.359
Skill-Based Teaching of CT	5	1.126	0.428	1.824			

Table 11 shows that all effect sizes are positive, and the studies which used the skill-based teaching of CT have a higher effect size (g=1.126) than the studies which used the content-based teaching of CT (g=1.111). The effect sizes calculated for both groups are strong. In addition, the Q value was found 0.842 in the heterogeneity test performed to determine whether the effect sizes differ significantly. This value is below the critical value of 3.841 which is prescribed for 1 degree of freedom and at significance level of 95% in the X^2 table. The achieved p value achieved in the statistics is also above 0.05 (p=0.35). Therefore, there is no significant difference between the effect sizes of the studies investigating the effect of content-based teaching of CT on CT skills and the studies investigating the skill-based teaching of CT on CT skills (Q= 0.842; p= 0.35). To sum up, one can conclude that students' CT skills would improve at the same rate in either content-based or skill-based teaching of CT.

Conclusion and Discussion

This study aimed to determine to what extent the content-based and skill-based teaching of CT is effective in improving the CT skill. As a result of the literature review performed to this end, 21 results of 17 research studies were included in the meta-analysis.

The first question of this study aimed to determine the effect level of the content-based teaching of CT on CT skill and whether this effect level differs by some variables. The general effect size of the content-based teaching of CT on CT skill is 1.111 with an error of 0.121 according to the random effects model. This effect value falls within the strong range. Hence, it is possible to state that the content-based teaching of CT is strongly effective in improving students' CT skills. It follows that a content-based teaching of CT can be carried out to improve students' CT skills. Aiming to re-evaluate the qualitative studies on CT skill in the literature with the meta-synthesis method, Polat (2015) concluded that CT activities integrated into in the curriculum on the content basis are highly effective in enhancing students' CT skills. Tiruneh, Verburgh, and Elen (2014) found that CT skills were significantly improved in approximately

65% of the experimental studies on the content-based teaching of CT which they reviewed. Therefore, the result that the content-based teaching of CT is strongly effective in improving the CT skills coincides with the results in the literature.

This effect level does not differ significantly by whether the sample group is gifted or normal students (Q=0.606; p= 0.436) and by educational level of sample groups (Q=4.574; p=0.206). However, although the difference is not statistically significant, one can argue that the effect size of the studies working with gifted students (g=1.247) is higher than the effect size (g=1.039) of the studies working with normal students. It is also possible to state that the studies working with university students have the highest effect size (g=1.341) among the sample groups formed by the educational level. University students are followed by primary school students (g=1.172), secondary school students (g=1.151) and high school students (g=0.704), respectively. The calculated effect size values are strong for all groups except high school students. The effect size calculated for high school students is moderate. Systematically reviewing 33 experimental studies which discussed the teaching of CT, Tiruneh, Verburgh and Elen (2014) concluded that the educational level of sample group does not significantly affect the achievement of content-based or skill-based teaching of CT in promoting the CT skills. Similarly, there are other studies showing that the educational level of sample group does not affect the success of CT teaching (Chau et al., 2001; Hitchcock, 2004). It is therefore possible to argue that the results of this study are in parallel with the results of many studies in the literature.

The second question of the study aimed to determine the effect level of skill-based teaching of CT on CT skills. According to the random effects model, the general effect size of the skill-based teaching of CT on CT skill is 1.126 with an error of 0.356. This effect value is strong. Hence, one can argue that the skill-based teaching of CT is strongly effective in improving students' CT skills. According to Bangert-Drowns and Bankert (1990), who aimed to combine and interpret the results of studies based on skill-based teaching of CT with the meta-analysis method, the skill-based teaching of CT was strongly and significantly effective in improving students' CT skills. This result achieved by Bankert-Drowns and Bankert (1990) coincides with the results obtained in this study. In parallel with the results of this research, Tiruneh, Verburgh, and Elen (2014) found that CT skills were significantly improved in approximately 80% of the experimental studies on the skill-based teaching of CT which they reviewed.

The third question of the research aimed to determine whether there is any difference between the effect levels of content-based and skill-based teaching approach of CT on CT skills? It can be argued that the effect size (g=1.126) of the studies which applied the skill-based teaching of CT is higher than the effect size (g=1.111) of the studies which applied the content-based teaching of CT. The effect sizes calculated for both groups correspond to the strong level. In addition, it was observed that the difference was not significant in the heterogeneity test which was performed to see whether the effect sizes achieved for both approaches differ significantly (Q=0.842; p=0.35). Analyzing the experimental studies that applied CT teaching, Bankert-Drowns and Bankert (1990) concluded that there was no significant difference between the effect sizes of the studies using the content-based approach and the studies using the skill-based approach. Likewise, Behar-Horenstein and Niu (2011), who reviewed the experimental

studies on CT, found that the studies which teach CT on the skill basis are more effective in improving CT skills than the studies which prefer the content-based teaching. However, they also state that this difference is not too much. Furthermore, Abrami et al. (2008) reviewed 117 studies on CT teaching with the meta-analysis method and concluded that there were no significant differences among the effect sizes of the content-based, skill-based and mixed approaches of CT even though the content-based approach had a lower effect size. In another study aiming to combine the results of 341 experimental studies that teach CT with the meta-analysis method, Abrami et al. (2015) similarly concluded that the content-based and skill-based approaches were equally effective in promoting CT skills. Examining 33 experimental studies using different CT teaching approaches, Tiruneh, Verburgh and Elen (2014) state that the studies using skills-based approach are more successful in improving CT skills than the studies using the content-based approach. However, according to Tiruneh, Verburgh and Elen (2014), this difference between the two teaching approaches is not significant. It is therefore possible to argue that the results obtained in the literature coincide with the results of this research. In addition, according to Arrington (2017), who reviewed the CT teaching in 8 public universities with methods such as interview, scale and document review, more than half of the faculty members (58.62%) working in universities think that CT should be taught on the content basis. On the other hand, the remaining group thinks that the skill-based approach is more effective in teaching CT. Therefore, it can be stated that there is not an agreement on CT teaching approaches and the number of the group that advocates the content-based and skill-based approaches is close to each other in Arrington's (2017) study. In accordance with this result, the meta-analysis through this study revealed that the two teaching approaches are not superior to each other in improving CT skills.

In short, this study found answers to the questions "To what extent is the content-based teaching approach of CT effective in improving CT skills?", "To what extent is the skill-based teaching approach of CT effective in improving CT skills?", and "Which of the teaching approaches of CT is more effective in improving CT skills?" According to the results, the content-based and skill-based approaches in CT teaching have a strong effect on the improvement of CT skills. Furthermore, there is no significant difference between these two approaches in terms of improving CT skills. It is thought that answering these questions to which more importance is ascribed fulfills the gap in the literature in Turkey and gives an idea to other researchers and practitioners. In the light of these results, the following recommendations can be provided for other researchers and practitioners:

- The content-based and skill-based teaching approaches of CT can be used to promote CT skills on all education levels.
- Students can be provided with CT skills by integrating these skills into the curricula of primary, secondary and high schools on the content basis along their entire educational life.
- On university level, CT skills can be taught on the skill basis in a separate course.
- Based on the conclusion that CT skills can be strongly improved with these two approaches, in-service trainings can be given to teachers in these two approaches so that they can use them effectively in their courses.

- Limited number of experimental studies conducted with the content-based and skill-based approaches can be regarded as a limitation to this study. Hence, the meta-analysis study can be repeated and more exhaustive results can be achieved once there are more of the said studies.
- The results of the experimental studies conducted abroad on CT skills can be combined in a similar meta-analysis study, and its results can be compared with the results of this study.

The Effect of Different Critical Thinking Teaching Approaches on Critical Thinking Skills: A Meta-Analysis Study başlıklı çalışmanın yazım sürecinde bilimsel, etik ve alıntı kurallarına uyulmuş; toplanan veriler üzerinde herhangi bir tahrifat yapılmamış, karşılaşılacak tüm etik ihlallerde "**Pamukkale Üniversitesi Eğitim Fakültesi Dergisi Yayın Kurulunun**" hiçbir sorumluluğunun olmadığı, tüm sorumluluğun Sorumlu Yazara ait olduğu ve bu çalışmanın herhangi başka bir akademik yayın ortamına değerlendirme için gönderilmemiş olduğunu taahhüt ederim.

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Appendix 1: The Studies Included in Meta-Analysis

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Appendix 2: Coding Form

Name of Study					
Author					
Instrument					
Sample					
Field					
CT Teaching Approach					
	Pre Test	ss	Post Test	ss	Number
Treatment Group					
Control Group					

Geniş Özet

Giriş

Eleştirel düşünme yorumlama, analiz, değerlendirme, çıkarımda bulunma ve kanıtları sorgulama gibi becerileri içeren bilinçli ve öz düzenleyici bir düşünme süreci olarak tanımlanmaktadır (Facione, 1990). Watson-Glaser'e göre (2010) ise eleştirel düşünme süreci bir sorunun varlığını fark etme, bilgilerin kaynağını ve kanıtların doğruluğunu sorgulama, farklı verileri ve kanıtları değerlendirme gibi becerileri içinde barındırır.

Eleştirel düşünme öğretimi konusunda farklı araştırmacılar tarafından farklı yaklaşımların benimsendiğini söylemek mümkündür (Beyer, 1987; Resnick, 1987; Lipman, 1988). Alanyazındaki bu çalışmalar incelendiğinde eleştirel düşünme becerilerinin öğretiminde üç temel yaklaşımın yaygın bir şekilde kullanıldığını söylemek mümkündür. Bu yaklaşımlar içerik temelli eleştirel düşünme öğretimi yaklaşımı, beceri temelli eleştirel düşünme öğretimi yaklaşımı ve karma eleştirel düşünme öğretimi yaklaşımıdır. Bu yaklaşımların ilkine göre eleştirel düşünme becerileri bir dersin içeriğine entegre edilerek öğretilir. Beceri temelli eleştirel düşünme öğretimi yaklaşımı ise eleştirel düşünme becerilerinin eğitim programı içinde yer alan derslerin içeriğinden bağımsız bir şekilde farklı bir ders olarak öğretilmesi gerektiğini savunur (Sternberg, 1985). Karma eleştirel düşünme öğretim yaklaşımında ise, eleştirel düşünme öğretimi önce beceri temelli olarak başlar daha sonra ise içerik temelli olarak devam eder (Perkins ve Salomon, 1989). Dolayısıyla her yaklaşımın savunucuları eleştirel düşünme öğretim yaklaşımlarının farklı avantajlı ya da dezavantajlı yanlarından bahsetmektedir.

Türkiye'deki içerik temelli ve beceri temelli eleştirel düşünme öğretiminin eleştirel düşünme becerisi üzerindeki etkisini araştıran çalışmalar incelendiğinde, hangi eleştirel düşünme öğretimi yaklaşımının eleştirel düşünme becerisini geliştirmede daha etkili olduğu sorusuna cevap bulunamamaktadır. Bu sebeple "içerik temelli ve beceri temelli eleştirel düşünme öğretim yaklaşımları eleştirel düşünme becerisini geliştirmede ne derece etkilidir?" sorusu bu araştırmanın problem durumunu oluşturmaktadır. Bu amaç doğrultusunda şu sorulara cevap aranmıştır:

1. İçerik temelli eleştirel düşünme öğretim yaklaşımlarının eleştirel düşünme becerisi üzerindeki etki düzeyi nedir?
   a. Bu etki düzeyi farklı değişkenlere (örneklem grubunun normal yetenekli ya da üstün yetenekli olması ve örneklem grubunun öğretim seviyesi) göre farklılaşmakta mıdır?
2. Beceri temelli eleştirel düşünme öğretim yaklaşımlarının eleştirel düşünme becerisi üzerindeki etki düzeyi nedir?
3. İçerik temelli ve beceri temelli eleştirel düşünme öğretim yaklaşımlarının eleştirel düşünme becerisi üzerindeki etki düzeyleri arasında fark var mıdır?

Araştırmanın Modeli

İçerik temelli ve beceri temelli eleştirel düşünme öğretim yaklaşımlarının eleştirel düşünme becerisi üzerindeki etkisini belirlemeyi amaçlayan bu çalışmada meta analiz yöntemi kullanılmıştır. Araştırma kapsamında önce çalışmalar toplanmış, sonra bu çalışmalar kodlanmış ve veriler analiz edilmiştir.

Tartışma, Sonuç ve Öneriler

Bu çalışmanın birinci sorusunda içerik temelli eleştirel düşünme öğretim yaklaşımının eleştirel düşünme becerisi üzerindeki etki düzeyinin belirlenmesi ve bu etki düzeyinin bazı değişkenlere göre farklılaşıp farklılaşmadığının belirlenmesi amaçlanmıştır. İçerik temelli eleştirel düşünme öğretiminin eleştirel düşünme becerisine etkisine ilişkin genel etki büyüklüğü değeri, rastgele etkiler modeline göre ve 0,121 hata ile 1,111'dir. Bu etki değeri Cohen, Manion & Morrison'ın (2007) sınıflandırmasında güçlü düzey aralığına denk gelmektedir. Dolayısıyla içerik temelli eleştirel düşünme öğretim yaklaşımının öğrencilerin eleştirel düşünme becerisini geliştirmede güçlü düzeyde etkili olduğunu söylemek mümkündür. Bu sebeple öğrencilerin eleştirel düşünme becerisini geliştirmek amacıyla içerik temelli bir eleştirel düşünme öğretimi gerçekleştirilebilir. Bu çalışmada elde edilen içerik temelli eleştirel düşünme öğretimi yaklaşımının eleştirel düşünme becerisini geliştirmede güçlü düzeyde etkili olduğu sonucu alanyazında elde edilen sonuçlarla (Polat, 2015; Tiruneh, Verburgh ve Elen, 2014) örtüşmektedir.

Bu etki düzeyi örneklem grubunun üstün yetenekli ya da normal yetenekli olmasına göre (Q=0,606; p=0,436) ve örneklem grubunun öğretim seviyesine göre (Q=4,574; p=0,206) anlamlı bir şekilde farklılaşmamaktadır. Ancak her ne kadar aradaki fark istatistiki olarak anlamlı olmasa da, üstün yetenekli öğrenciler ile çalışan araştırmaların etki büyüklüğünün (g=1,247), normal yetenekli öğrenciler ile çalışan araştırmaların etki büyüklüğünden (g=1,039) yüksek olduğunu söylemek mümkündür. Ayrıca örneklem grubunun öğretim seviyesine göre oluşturulmuş gruplar arasında en yüksek etki büyüklüğüne üniversite öğrencileriyle çalışan araştırmaların sahip olduğunu söylemek mümkündür (g=1,341). Üniversite öğrencilerini sırasıyla ilkokul öğrencileri (g=1,172), ortaokul öğrencileri (g=1,151) ve lise öğrencileri (g=0,704) takip etmektedir. Lise öğrencileri hariç bütün gruplar için hesaplanan etki büyüklüğü değerleri güçlü düzeydedir. Ancak lise öğrencileri için hesaplanan etki büyüklüğü orta düzeydedir.

Çalışmanın ikinci sorusunda beceri temelli eleştirel düşünme öğretim yaklaşımının eleştirel düşünme becerisi üzerindeki etki düzeyinin belirlenmesi amaçlanmıştır. Beceri temelli eleştirel düşünme öğretiminin eleştirel düşünme becerisine etkisine ilişkin genel etki büyüklüğü değeri, rastgele etkiler modeline göre 0,356 hata ile 1,126'dır. Bu etki değeri Cohen, Manion & Morrison'ın (2007) sınıflandırmasında güçlü düzey aralığına denk gelmektedir. Dolayısıyla beceri temelli eleştirel düşünme öğretim yaklaşımının öğrencilerin eleştirel düşünme becerisini geliştirmede güçlü düzeyde etkili olduğunu söylemek mümkündür. Bu çalışmada elde edilen içerik temelli eleştirel düşünme öğretimi yaklaşımının eleştirel düşünme becerisini geliştirmede güçlü düzeyde etkili olduğu sonucu alanyazında elde edilen sonuçlarla (Bangert-Drowns ve Bankert, 1990; Tiruneh, Verburgh ve Elen, 2014) örtüşmektedir. Bu araştırmada beceri temelli eleştirel düşünme öğretimini kullanan çalışmaların çoğunluğu üniversite öğrencileriyle yapıldığı için, örneklem grubunun öğretim seviyesine ilişkin gruplama yapılamamış ve bu gruplar arasında karşılaştırma yapılamamıştır.

Çalışmanın üçüncü sorusunda ise içerik temelli ve beceri temelli eleştirel düşünme öğretim yaklaşımlarının eleştirel düşünme becerisi üzerindeki etki düzeyleri arasında fark olup olmadığının belirlenmesi amaçlanmıştır. Beceri temelli eleştirel düşünme öğretimi yapılan çalışmaların etki büyüklüğünün (g=1,126), içerik temelli eleştirel düşünme öğretimi yapılan çalışmaların etki büyüklüğünden (g=1,111) yüksek olduğu söylenebilir. Ancak her iki grup için

de elde edilen etki büyüklüğünün güçlü düzeye karşılık gelmektedir. Ayrıca her iki yaklaşım için elde edilen etki büyüklüklerinin anlamlı bir şekilde farklılaşıp farklılaşmadığını belirlemek için yapılan heterojenlik testi sonucunda aradaki farkın anlamlı olmadığı görülmüştür (Q=0,842; p=0,35). Bu çalışmada elde edilen içerik temelli eleştirel düşünme öğretimi yaklaşımının eleştirel düşünme becerisini geliştirmede güçlü düzeyde etkili olduğu sonucu alanyazında elde edilen sonuçlarla (Abrami vd., 2008; Abrami vd., 2015; Arrington, 2017; Bangert-Drowns ve Bankert, 1990; Behar-Horenstein ve Niu, 2011; Tiruneh, Verburgh ve Elen, 2014) örtüşmektedir. Elde edilen sonuçlar ışığında diğer araştırmacılara ve uygulayıcılara şu önerilerde bulunabilir:

- İçerik temelli ve beceri temelli eleştirel düşünme öğretim yaklaşımı bütün öğretim seviyelerinde eleştirel düşünme becerisinin geliştirilmesinde kullanılabilir.
- Eleştirel düşünme becerisi ilkokul, ortaokul ve lise öğretim programlarının içine entegre edilerek içerik temelli bir şekilde bütün öğretim hayatı boyunca öğrencilere kazandırılabilir.
- Üniversite seviyesinde ise eleştirel düşünme becerisi ayrı bir ders altında beceri temelli olarak öğretilebilir.
- Eleştirel düşünme becerisinin bu iki yaklaşımla güçlü düzeyde geliştirilebildiği sonucundan hareketle, öğretmenlerin bu iki yaklaşımı etkili bir şekilde derslerinde kullanabilmeleri için bu iki yaklaşım üzerine öğretmenlere hizmet içi eğitimler verilebilir.
- Türkiye'deki içerik temelli ve beceri temelli yaklaşımlar ile yapılan deneysel eleştirel düşünme öğretim çalışmalarının sayıca az olması bu çalışmanın sınırlılığı olarak görülebilir. Dolayısıyla bahsedilen çalışmaların sayısı arttığında meta analiz çalışması tekrarlanabilir ve daha kapsamlı sonuçlar elde edilebilir.
- Eleştirel düşünme becerisi üzerine yurt dışında yapılmış deneysel çalışmaların sonuçları benzer bir meta analiz çalışmasıyla birleştirilerek, elde edilen sonuçların bu çalışmayla kıyaslaması yapılabilir.