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The Effect of Student-Centered Approaches on Students' Creative Thinking Skills: A Meta-Analysis Study

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Abstract

The aim of this study is to determine the effects of student-centered approaches (SCA) on students' creative thinking skills (CTS). Meta-analysis method is used in the study. The scope of the study consists of Master and PhD theses and research articles addressing this issue in Turkey. As a result of the screening, it is seen that there are 104 studies between 1990 and 2020 in line with inclusion criteria. The total number of samples within the scope of these studies is 6434 students. 3215 of these students are in the experimental group and 3219 are in the control group. According to the results of the study and the random effects model, a moderate (d=0.73; [0.63; 0.82]) statistically significant, positive effect size is determined according to SCA in favor of the students' CTS. In other words, it is seen that when student-centered approaches and methods are applied in the lessons, creative thinking skills of students are positively affected. As a result of the moderator analysis, it is determined that the effect sizes of the studies differed according to education stage (p=0.00) and lessons (p=0.00). In the study, it is concluded that SCA is a meaningful variable that positively affects students' CTS.

Key words: Student centered, learner centered, creative thinking, meta-analysis.

Introduction

In the twenty-first century, it is expected to raise individuals with advanced thinking skills who can question, produce and use knowledge in the solution of problems. Raising this globally valued human profile has taken its place among the educational objectives of all countries. The question "*How can we raise individuals with advanced thinking skills?*" has led to many new approaches in education. One of the best ways to use thinking skills effectively is to make individuals active in their learning processes. In this context, student-centered approaches (SCA) such as active learning, learning by living and learning to learn shape today's education.

Instead of using a single teaching method or certain techniques, SCA transform the role of the teacher from the person who conveys information to person who create learning environments that facilitate learning. It is not possible for teachers who have adopted SCA to use a single teaching method in lessons (Darsih, 2018). Methods that facilitate learning and activate students is within the scope of SCA (Blumberg, 2008). Student-centered teaching is an approach that focuses on student learning rather than what the teacher does, respects student learning needs, learning styles and strategies, and puts the student at the center of learning (Blumberg, 2008; Brown, 2003). In student-centered classes, students work individually, in pairs or with small groups on different tasks and projects. Successful control of such a classroom environment is possible with comprehensive planning and effective classroom management (Brown, 2003). SCA allows the student to make sense of the content in student-centered classroom settings and allows the teacher to help students in this regard. In addition, SCA, which develops higher order thinking skills that are suitable for learning objectives and students' characteristics, is frequently used in effective classroom settings (Weimer, 2002). Trilling and Fadel (2009) and Yalçın (2018) state that using SCA in classroom improves students' thinking skills. In this context, it can be said that there is a significant relationship between SCA and thinking skills.

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Other than basic skills, twenty-first century skills consist of three main skill areas: a) learning and innovation skills, b) knowledge, media and technology skills, and c) life and career skills. Learning and innovation skills consist of four sub-skills: critical thinking and problem solving, communication, cooperation and creativity. These skills are seen as the key to lifelong learning and creative thinking. Creativity means producing, evaluating, explaining and implementing new ideas. Creative thinking is a higher order thinking skill that aims to solve problems, present alternative ideas and solutions, synthesize or make sense through re-meaning, and use imagination (Kylonen, 2012; Özçelik, 2019; Trilling & Fadel, 2009; Yalçın, 2018). In the document Turkey's Education Vision 2023, emphasis is placed on an educational approach based on these four soft skills of 21st Century which are to be acquired by students (MEB, 2018). On a global scale, it is stated in many countries from Finland to Singapore that 9 of every 10 skills that will shape the future in 2020 and beyond are creativity or other creativity related skills. Creative thinking skills are at the top of the skills students need to learn (Trilling & Fadel, 2009; World Economic Forum, 2016).

SCA is expected to develop higher order thinking skills such as creative, critical and reflective thinking (American Psychological Association [APA], 1997; Perry & Karpova, 2017). It is generally known that creativity skills of students are not given importance in educational environments. Accordingly, it is seen that teachers keep the level of creativity and general intelligence equal (Sternberg, 2003). However, there are studies showing that the student's general intelligence or academic achievement and creativity are not directly related (Gajda, Karwowski & Beghetto, 2017; Kim, 2005). Torrance (1966) defines creativity as "*being sensitive to problems, malfunctions, lack of information, lost items, incompatibility, seeking solutions to difficulties and predicting*". So creative thinking can be defined as mental processes that lead to an invention, solution or synthesis in any field (Vanderbos, 2006). In short, individuals with higher CTS can produce different or original ideas in a wide variety of fields and make predictions based on existing situation. While creativity evokes both mental and performance-based activities, creative thinking evokes mostly cognitive activities (Doğan, 2005). Creative thinking individual produces new, original, unexpected, appropriate, useful and adaptable concrete objects and ideas (Sternberg & Kaufman, 2010). The importance of knowledge and motivation is emphasized in creativity (Runco & Chand, 1995). In order to talk about creativity in any subject, we encounter two important factors; the level of knowledge on the subject and the desire to discover. The motivation mentioned in creativity is mostly intrinsic motivation. When the student is free to choose the tasks in the teaching process, his motivation increases because this makes the task meaningful to the student. Thus, in order to increase the creativity of students, it is necessary to take advantage of SCA, which will make them active in the teaching process.

The aim of pedagogy, which develops innovation and creative thinking skills, is to provide students with the necessary equipment to be creative, be prepared for problems to be able to analyze and manage information and work with it. Teachers who want to see the effects of using SCA to develop students' CTS, provide feedback and guide their learning to help students think creatively about content in terms of achievement and content. Students are encouraged to become independent active learners. Student centered approaches and methods are used in this process (Drapeau, 2014; Özçelik, 2009).

Educational approaches that center the student include many different teaching strategies, methods and techniques. It is seen that meta-analysis studies on the subject are concentrated on the effects of these student-centered strategies, methods and techniques on students' academic success. There are many meta-analysis studies examining the effect of inquiry-based learning (Aktamış, Hiğde & Özden, 2016; Furtak, Seidel, Iverson & Briggs, 2012; Wang, Huang, Tsay, Lee, Lin & Kao, 2011), constructivist approach (Arık & Yılmaz, 2020; Erdamar, Aytaç, Demir & Demir, 2015; Tutal, Kaçire & Atabey, 2016), project based learning (Ayaz, 2014; Kaşarcı, 2013; Tutal, Kaçire & Atabey, 2016), multiple intelligence theory (Ayaz, 2014; Baş, 2016; Biçer, 2017; Çelik, 2013; Kaplan, Duran & Baş, 2015; Tutal, Kaçire & Atabey, 2016), active learning (Batdı, 2014), technology-based methods (Batdı, 2014b; Çelik, 2013; Çırak-Kurt, Yıldırım & Cücük, 2018; Demir & Başol, 2014; Kaya & Öçal, 2018; Li & Ma, 2010; Merchant, Goetz, Cifuents, Keeney-Kennicutt,& Davis, 2014), STEM (Becker & Park, 2011; Belland, Walker, Kim & Lefler, 2017), creative drama (Biçer, 2017; Cantürk Günhan, 2016; Çelik, 2013; Erden, Aytaç & Erden, 2016; Lee, Patall, Cawthon & Steingut, 2015; Tutal, Kaçire & Atabey, 2016; Özbey & Sarıkaya, 2019) collaborative learning (Biçer, 2017; Camnalbur & Mutlu-Bayraktar, 2018; Capar & Tarim, 2015; Çelik, 2013; Johnson, Johnson & Stanne, 2000), game based learning (Biçer, 2017), problem based learning (Çelik, 2013; Dağyar, 2014; Dochy, Segers, Bossche, & Gijbels, 2003; Tutal, Kaçire & Atabey, 2016), brain based learning (Gözüyeşil & Dikici, 2014), argumentation technique (Karakuş & Yalçın, 2016; Tutal, Kaçire & Atabey, 2016), concept maps (Okursoy-Günhan, 2019) and student centered

approaches (Tutal, Kaçire & Atabey, 2016; Yeşilpınar Uyar & Doğanay, 2018) on students' academic achievement.

It is seen that meta-analysis studies in the literature focus on different variables as well as the effects of SCA on students' academic achievement. It is noteworthy that there are also meta-analysis studies investigating the effect of research and inquiry-based teaching on students' scientific process skills (Akkaya, 2019); project-based learning on science lesson attitude (Ayaz, 2014; Kaşarcı, 2013); 5E learning model (Ayaz, 2015) and constructivist approach on lesson attitudes (Ayaz & Şekerci, 2016); cooperative learning on mathematics attitude (Capar & Tarim, 2015); technology-based methods on learning mathematics (Özdemir, Aslaner & Açıkgül, 2020) and foreign languages (Chiu, Kao & Reynolds, 2012; Peterson, 2010); web-based problem solving (Kuo, Chen and Hwang, 2014); argumentation technique on scientific process skills (Karakuş & Yalçın, 2016); creative drama on motivation and social skills (Özbey & Sarıkaya, 2019) and skill development (Cruz, Lian & Morreau, 1998; Ulubey, 2018). However, when the studies conducted in Turkey and other countries, no meta-analysis study is found to examine the effects of SCA on students' CTS.

The question *"is there a relationship between SCA applied in the class and the students' CTS?"* has been asked for a long time, but there is no clear answer yet. At the conceptual level, scientists claimed that creativity and learning represent interrelated phenomena (Beghetto, 2016; Sawyer, 2012; Vygotsky, 2004). It is seen that there are many studies in Turkey in recent years dealing with the effects of SCA on thinking skills of students. The increasing number of studies dealing with the effect of various student-centered approaches, methods and techniques on students' creative thinking skills (CTS) has revealed the need to compile these results and synthesize them by taking into account the sample numbers. However, it is seen that there are no meta-analysis studies that deals with the effects of SCA on students' CTS. In addition, it is seen that there are no holistic and comparative studies that examine the effects of SCA on students' CTS. In this context, determining whether SCA has an impact on the students' CTS is the problem of this study. The aim of this study is to determine the effects of SCA on students' CTS.

Method

Research Design

Research model of the study is meta-analysis method, which is a method of systematically analyzing and synthesizing the data of quantitative studies carried out independently on the same subject. In the analysis of the data, one of the group comparison meta-analysis methods, Group Difference Method is used (Card, 2012; Cumming, 2012, 205). In a meta-analysis study; single and independent quantitative studies related to the same research question and subject are selected according to the inclusion criteria and the data obtained from these studies are synthesized with advanced statistical methods and their effect sizes are determined and interpreted (Dinçer, 2014; Ellis, 2012:5). The purpose of a meta-analysis is to reach a synthesis with the least error by comparing the quantitative data obtained from empirical studies conducted in different places and times on the same subject, combining them with appropriate methods, increasing the number of samples and thereby reducing the confidence interval of the overall result (Cumming, 2012; Hartung, 2008). Meta-analysis process steps are shown in Figure 1 (Dinçer, 2014, 11).

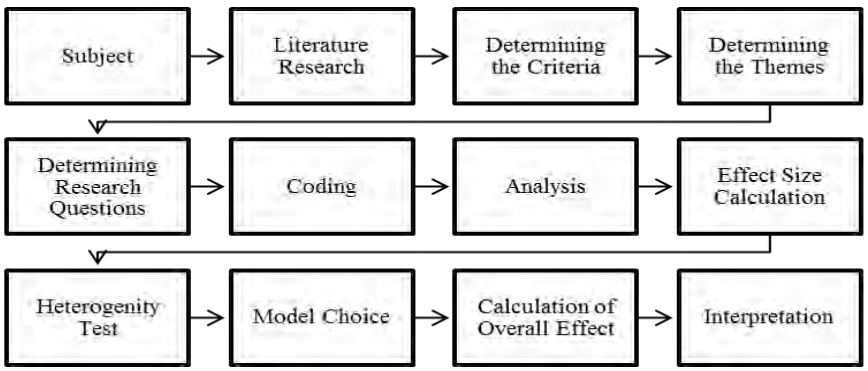

Figure1. Meta-analysis process steps

Data Collection

Master's and PhD theses, and research articles (conference paper, book chapter etc.) which discuss the subject of this study in Turkey constitute the main data sources and scope of this study. In order to have access to the relevant studies, the keywords "creativity", "creative thinking", "learner/student centered", "student centered strategies", "teaching strategies and methods" are searched both in Turkish and English on Web of Science, ERIC, ULAKBİM, EBSCOhost, Google Scholar and YOK National Thesis Center databases. After the search, it is determined that there are 104 studies in accordance with the inclusion criteria from 187 studies conducted on the subject of the study. In this study, studies focusing on experimental and quasi-experimental studies are selected which especially have pretest-posttest, and comparisons between groups. The inclusion criteria used in the selection of the studies included in the research are given in Table 1.

Table 1. Inclusion Criteria of the Studies

Inclusion Criteria
1. *Published or unpublished study sources*: Master's and PhD theses and research articles published in the literature are covered.
2. *Appropriateness of the dependent and independent variables in the studies to the meta-analysis study*: In order to reach the effect size in the meta-analysis studies it is taken into account that the included studies are empirical studies and that SCA is used as an independent variable and CTS is used as a dependent variable.
3. *Sample group*: Studies involving students who are studying in the formal education institutions from preschool education up to postgraduate education in Turkey are included.
4. *Containing the quantitative data required for meta-analysis*: It is taken into account that studies contain quantitative data (mean, standard deviation, number of samples, p value, etc.) in order to calculate the effect sizes required for the meta-analysis study.
5. Studies carried out in Turkey between 1990 and 2020 are taken into account.
6. Studies in both Turkish and English languages with a sampling from Turkey are included in scope.

The process of determining the studies included in the meta-analysis according to the inclusion criteria mentioned above is given in Table 2.

Table 2. The Process of Determining the Studies Included in the Scope of Meta-analysis

1. Number of studies reached within the context of determined keywords	2. Number of studies not included in the scope according to exclusion criteria	3. Number of studies in accordance with inclusion criteria
187 studies (34 PhD thesis, 98 Master thesis, 55 Articles)	83 studies (11 PhD thesis, 51 Master thesis, 21 Articles)	104 studies (23 PhD thesis, 47 Master thesis, 34 Articles)

Reliability of the Research. In a meta-analysis study, reliability between coders is important in the coding phase of the studies related to the reliability of the results. For this purpose, a coding protocol and form containing the identity, content and data of the study are created. In order to ensure the reliability of coding, the studies that will be included in the meta-analysis must be coded by at least two coders (Cooper, 2009; Wilson, 2009). The reliability of the codings was calculated using the formula "Reliability=Consensus/(Consensus + Disagreement) x 100" (Miles and Huberman, 1994) and was 96%. Values of 70% and above obtained from this formula are sufficient for reliability (Yıldırım & Şimşek, 2011). It can be said that the codings performed in this framework are reliable.

Validity of the research. All studies that meet the inclusion criteria for the meta-analysis are searched on all available databases and their inclusion is an indication of the validity of the research (Petticrew, & Roberts, 2006). In this context, each of the 104 studies included in the meta-analysis are examined in detail, and it is confirmed that the validity and reliability of the data collection tools used in studies are provided. Therefore, it can be said that this meta-analysis study is also valid.

Reporting. "Preferred Reporting Items for Systematic Reviews and Meta Analysis (PRISMA)" writing guide, which is a protocol used for systematic review and meta analysis, is used in the reporting of this study (Moher, Liberati, Tetzlaff & Altman, 2009). Turkish translation of the PRISMA checklist is made by Aşık & Özen (2019); Turkish version published on the official website of PRISMA is used (Aşık & Özen, 2019; Prisma Checklist, 2019: Figure 2).

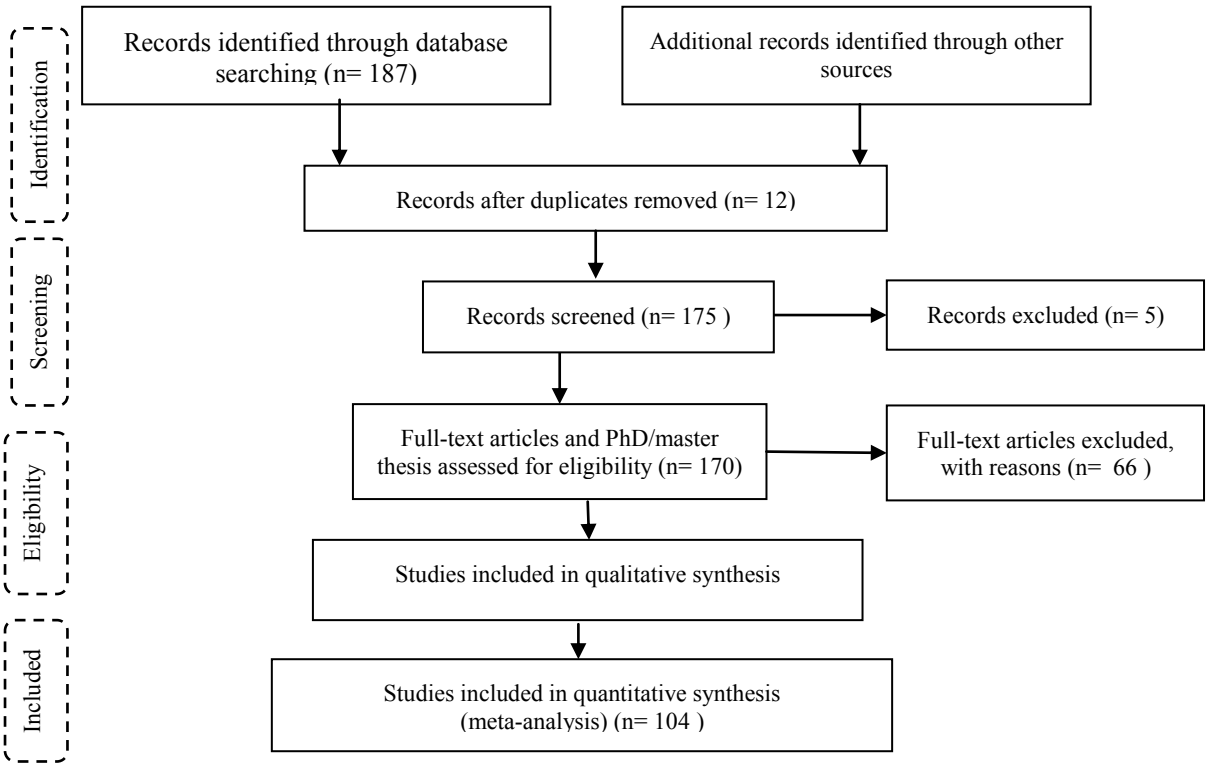

Figure 2. Prizma Flow Diagram for Meta-analysis

Data Analysis

For statistical calculations of this study, CMA [Comprehensive Meta Analysis] Ver. 2 software is used. In this meta-analysis study, random effects model is used to calculate the overall effect size. In the random effects model, universe effect sizes are assumed to vary from study to study, and studies included in the meta-analysis are considered to be part of a distribution. When studies are obtained from published literature, it is appropriate to use random effects model. When the samples of the studies within the scope of meta-analysis show a heterogeneous structure, random effects model can be used. Furthermore, if the researcher wants to generalize the universe and has a representative sample of the universe, it is appropriate to select the random effects model (Borenstein, Hedges, Higgins, & Rothstein, 2013; Başol, 2016; Başol, Doğuyurt & Demir, 2016; Ellis, 2012). Thus, it is predicted that it would be more appropriate to use the random effects model since the studies vary both in patterns and variables, that is, they are heterogeneous. In the study, students in the classes where SCA are applied are taken as experimental group and students in the classes where SCA are not applied are taken as control group. Therefore, the positive effect size is interpreted in favor of the students in the classes where SCA are applied, and the negative effect size is interpreted in favor of the students in the classes where SCA are not applied.

Publication Bias

In this study, publication bias is calculated by using Funnel plot, Orwin's Fail-Safe N., Duval and Tweedie's Trim and Fill method, Egger's test, and Kendall's Tau coefficient (Borenstein, Hedges, Higgins, & Rothstein, 2009; Cooper, 2009). As seen in Figure 2, the majority of 104 studies included in the study are located towards the top of the figure and highly close to the combined effect size. In this sense, the funnel plot shows that there is no publication bias for the studies included in the study (Borenstein et. al., 2009). It can be said that there is no publication bias in this study according to the evidence that pointers of effect sizes and sample sizes take the form of a funnel, the peak point is at the same level as the actual effect size, and the effect sizes are gathered symmetrically at the top (Bakioğlu & Özcan, 2016; Borenstein et al., 2013). When the funnel plot is examined, it is seen that the studies are mostly within the boundaries of the graph and the number of studies showing asymmetric distribution is low. In other words, the majority of the studies in the distribution are not

concentrated on only one side. When the funnel plot is examined, it is seen that the studies are mostly within the boundaries of the graph and the number of studies showing asymmetric distribution is low. In other words, the majority of the studies in the distribution are not concentrated on only one side.

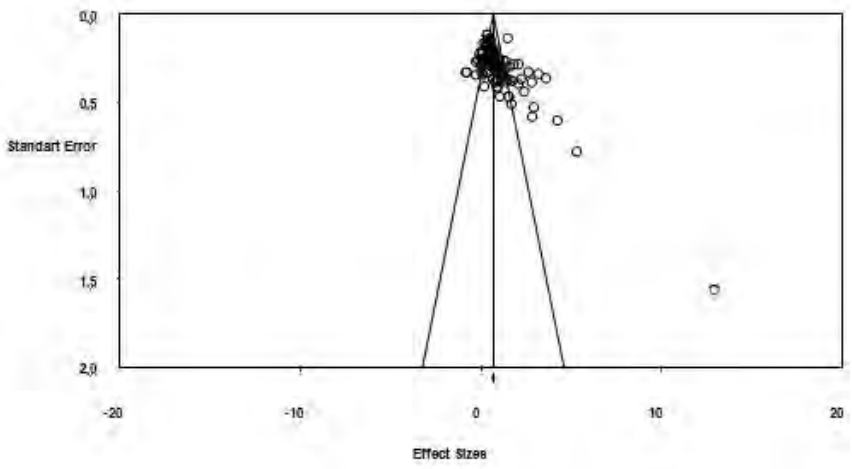

Figure 3. Funnel Plot

Publication bias test results of the studies included in the meta-analysis are given in Table 3. Orwin's Fail-Safe N calculation is also made to test publication bias. Orwin's Fail-Safe N calculates the number of studies that may be missing in a meta-analysis (Borenstein et al., 2009). As a result of this analysis, Orwin's Fail-Safe N is calculated as 6991. The number of studies required for the average effect size of 0.88 found in meta-analysis to reach 0.01 level (trivial), that is almost zero effect level, is 6991. 104 studies that are determined according to inclusion criteria are all of the studies conducted for this research question in Turkey. Apart from these, since 6991 studies are unlikely to be reached, this result is accepted as another indication that there is no publication bias in this meta-analysis.

The fact that the result of the Egger's test (p=0.08) was not significant is accepted as another indication that there is no publication bias in this meta-analysis. Another method, Kendall's Tau Coefficient is found to be 6.28 and p=0.41, so it is statistically revealed that there is no publication bias since the expectation that the p-value does not make a significant difference, i.e., greater than 0.05 is met. According to the results of Duval and Tweedie's Trim and Fill Method, when 29 precedent studies are included, the 0.88 average effect size found in the meta-analysis has changed to 0.49. This change can't be ignored, but it can be accepted that the reported effect size is reliable According to other tests, it may say that there is no publication bias, but a change from .88 to .49 should also be taken into consideration.

Results

Findings acquired from researches within the scope of meta-analysis study (random effects model, and moderator analysis) are given in this chapter.

Findings of Effect Sizes Combined by Fixed and Random Effects Model and Homogeneity Test Results

The mean of effect sizes regarding the effects of SCA on students' CTS which is combined according to the fixed and random effects model, standard error, and lower and upper limits in accordance with 95% confidence interval are given in Table 4.

Table 3. Combined Findings of the Effect Size Meta-Analysis of Studies by Fixed and Random Effects Model and Homogeneity Test

Model/Sub-dimension						Homogeneity		
Random effects	k	Effect Size	Standart Error	Lower Limit	Upper Limit	*P*-Value	Q-Value	I^2
RBL	1	0.09	0.21	-0.32	0.50	0.66		
AL	4	1.53	0.43	0.69	2.36	0.00		
AR	2	0.37	0.47	-0.56	1.30	0.44		

STH	1	1.37	0.36	0.66	2.07	0.00		
BBL	2	1.28	0.27	0.74	1.81	0.00		
TE	20	0.85	0.16	0.54	1.16	0.00		
DI	8	1.18	0.32	0.55	1.82	0.00		
CL	3	0.42	0.18	0.06	0.77	0.02		
GBL	3	1.25	0.65	-0.03	2.53	0.06		
CS	2	0.81	0.22	0.37	1.25	0.00		
ST	9	1.62	0.40	0.82	2.41	0.00		
PBL	13	0.53	0.13	0.28	0.78	0.00		
PJTL	8	0.82	0.21	0.41	1.23	0.00		
STEM	7	0.67	0.15	0.37	0.97	0.00		
TBL	7	0.70	0.10	0.51	0.88	0.00		
CD	9	1.19	0.37	0.46	1.91	0.00		
CWR	5	1.03	0.21	0.61	1.45	0.00		
DIMENSIONS	104	0.73	0.04	0.63	0.82	0.01	37.88	86.17

SCA: Thinking education (TE), Problem based learning (PBL), Creative drama (CD), Story telling (ST), Differentiated instruction (DI), Project Based Learning (PJTL), Science, technology, engineering, and mathematics (STEM), Technology-based learning (TBL), Creative writing-reading (CWR), Cooperative learning (CL), Game based learning (GBL), Argumentation (AR), Research-inquiry based learning (RBL), Active learning (AL), Brain-based learning (BBL), Case study (CS), Six thinking hats (STH).

As seen in Table 3, the average effect size value of the effect size values of the studies included in the study according to the random effects model according to the SCA variable is calculated as ES=0.73. According to the random effects model, the students in the SCA applied classes show that CTS is higher than the classes in which traditional teacher-centered approaches are used. In the interpretation of the effects size, Cohen (1988, 1992) proposed the standards for interpreting OR, SMD, and r shown in Table 4 (Bakioğlu & Özcan, 2016: Littell, Corcoran & Pillai, 2008). The effect size value of this study, ES = 0.73, can be evaluated as a medium effect size according to Cohen's classification.

Table 4. Cohen's (1988) Standards for Interpreting Effect Size (ES)

ES Metric	Small Effect	Medium Effect	Large Effect
OR	1.5	2.5	4.3
SMD	0.2 0	0.50	0,80
R	0.1	0.25	0.4

OR: odds ratio; SMD: standardized mean difference; R: correlation coefficient.

It is seen that, among SCA used in the teaching-learning process, approaches and methods that have the greatest impact on students' CTS are; story telling (*d*=1.62), active learning (*d*=1.53), six thinking hats (*d*=1.37), brain-based learning (*d*=1.28), game-based learning (*d*=1.25) and creative drama (*d*=1.19). On the other hand, it is seen that research-inquiry based learning (*d*=0.09), argumentation (*d*=0.37) and cooperative learning (*d*=0.42) have a lower level of effect on students' CTS.

Homogeneity Test and Q and I^2 Statistics

For homogeneity test, Q is calculated as 37.88 (Q=37.88). From the chi-square table, 16 degrees of freedom is found to be 7.96 at 95% significance level. Since the Q-statistic value (Q = 37.88) exceeds the critical value of the chi-square distribution with 16 degrees of freedom (χ2 0.95=7.96), the absence hypothesis of the distribution of effect sizes was rejected in the fixed effects model.

Recently, the I^2 index has been proposed to quantify the degree of heterogeneity in a meta-analysis (Huedo, Sanchez, Julio, Fulgencio and Botella (2006). I^2 shows the the ratio of the total variance of the effect size. I^2 reveals the percent variability of effect size estimates due to heterogeneity (Bakioğlu ve Özcan, 2016: 197). In addition, the 86.17 % value obtained as a result of calculating the I^2 value indicates high level of heterogeneity. The I^2 statistic describes the percentage of total variation across studies that is attributable to heterogeneity rather than chance (Higgins et al., 2003). A value greater than 25% is considered to reflect low heterogeneity,

50% moderate, and 75% high heterogeneity. In the interpretation of I^2, 25% indicates low level of heterogeneity; 50% indicates medium level of heterogeneity; and 75% indicates high level of heterogeneity (Cooper et. al., 2009, 263; Higgins et al., 2003). As a result of homogeneity tests (Q and I^2) for SCA variable, since there is a level of heterogeneity which is close to high level between studies, moderator analyzes are carried out to determine the possible causes of this heterogeneity.

Results of the Moderator Analysis According to SCA Variable

Results of the moderator analysis which was carried out in order to reveal the reasons of heterogeneity occurring as a result of SCA variable are given in Table 5.

Table 5. Categorical Moderator Results Related to the Effects of SCA on students' CTS

Moderator	k	d	SE	%95 CI	Q	*p*
Publication Type					3.77	0.15
MA	47	0.88	0.10	[0.67; 1.09]		
PhD	23	1.13	0.17	[0.78; 1.48]		
Article	34	0.74	0.09	[0.55; 0.93]		
Education Stage					22.10	0.00
Preschool	19	1.59	0.23	[1.14; 2.04]		
Primary	55	0.88	0.09	[0.70; 1.05]		
Secondary	9	0.31	0.20	[-0.08; 0.70]		
Higher	21	0.60	0.10	[0.40; 0.80]		
Lessons					130.5	0.00
Information Technologies	11	0.50	0.10	[0.31;0.70]		
Biology	1	0.54	0.15	[0.25;0.84]		
Geography	2	-0.79	0.23	[-1.25;-0.33]		
Thinking Education	2	1.22	0.25	[0.73;1.71]		
Philosophy	2	1.03	0.34	[0.35;1.70]		
Science	18	0.52	0.11	[0.32;0.73]		
Physics	1	0.62	0.20	[0.23;1.01]		
Visual Arts	3	0.92	0.20	[0.52;1.30]		
Life Science	2	0.49	0.42	[-0.33;1.30]		
English	1	0.19	0.41	[-0.61;0.99]		
Mathematics	10	0.95	0.21	[0.54;1.36]		
Preschool	19	1.60	0.23	[1.15;2.04]		
Assessment and Evaluation	1	2.64	0.33	[2.00;3.28]		
Free Activity	3	0.55	0.13	[0.29;0.80]		
Social Studies	9	1.69	0.46	[0.80;2.58]		
All Lessons	1	0.33	0.16	[0.01;0.64]		
Turkish	12	0.99	0.18	[0.65;1.34]		
Creative Drama	5	0.48	0.19	[0.10;0.86]		
Intelligence Games	1	1.41	0.27	[0.88;1.92]		
Region of the Study					5.22	
Mediterranean	9	0.88	0.13	[0.61; 1.14]		
Eastern Anatolia	12	0.91	0.20	[0.52; 1.30]		
Aegean	7	0.91	0.48	[-0.04; 1.87]		
Southeast	2	0.30	0.57	[-0.82; 1.44]		
Central Anatolia	31	1.12	0.14	[0.84; 1.39]		
Black Sea	13	0.74	0.14	[0.45; 1.03]		
Marmara	30	0.80	0.10	[0.59; 1.01]		
School Type					2.52	
State	86	0.88	0.07	[0.73; 1.02]		
Private	17	0.87	0.16	[0.55; 1.19]		
Science and Arts Center	1	1.69	0.50	[0.69; 2.69]		

P.S.: k=number of studies, d= Cohen's d

(SOF), SE=Standard Error CI=Confidence Interval, Q= Heterogeneity between studies, Comparison analyzes are made for studies with sub-dimension numbers of 2 or more. *p<.05

As a result of the moderator analysis, it is determined that the effect sizes of the studies differ according to the education stage (p=0.00) and lessons (p=0.00). The results of the studies dealing with the preschools in terms of education stage show that the students' CTS are higher (d=1.59) in favor of SCA variable. In terms of lessons, especially in preschool education stage (d=1,60), it is seen that when SCA are applied in Social Studies (d=1,69), Assessment and Evaluation (d=2,64), Turkish (d=0,99) and Mathematics (d=0, 95) lessons, students' CTS increased more compared to other lessons. As an interesting result, it is observed that the implementation of SCA in geography lessons does not have any effect on students' CTS (d=-0.79).

It is determined that the effect sizes of studies according to the publication type (p=0.15), school type (p=0.28), region of the study (p=0.51) does not differ significantly.

Conclusion and Discussion

In this study, 104 effect sizes are calculated from 104 studies constituting a sample of 6434. According to the results of the study, a statistically significant moderate effect size is determined according to the random effects model (d=0.73; [0.63; 0.82]) in favor of the students in the experimental group according to the SCA variable. This result is a medium level according to the classifications of Cohen (1988). The results of this meta-analysis study show that SCA practices are a significant variable that positively affects students' CTS.

According to the random effects model in the context of SCA variable, the result of a moderate positive difference in favor of the students' CTS is in parallel with the results of the researches conducted by Akar & Şengil Akar (2013), Akkılıç (2018), Akran & Aşıroğlu (2018), Aksoy (2018), Aktamış, Hiğde & Özden (2016), Altındağ et. al., (2012), Arkan Sezgin & Baysal (2019), Atalay (2014), Avcu (2014), Aydın (2011), Bacak (2008), Batdal Karaduman (2012), Birişçi & Karal (2011), Bulut (2015), Chung & Ro (2004), Çetinkaya (2014), Çolakoğlu (2018), Dere & Ömeroğlu (2018), Engin (2019), Kaya (2018), Terzi (2019), Tezci (2002), Tut (2018), Ülger & İmer (2013), Üret (2019), Yıldırım (2018), Yıldırım & Akman (2020), Yıldız (2012), Yiğit & Erdoğan (2008). The view that the use of SCA in lessons is effective in the development of higher order thinking skills of students, which also include CTS (Brown & Freeman, 2000; Galton, et. al., 2009; Pascarella, et al., 2013) supports this meta-analysis study. In the national and international literature, a meta-analysis study examining the effect of SCA on students' CTS is not found. In this context, it is not possible to compare the results of this study with the findings of other meta-analysis studies. No meta-analysis study dealing with the effect of various SCA on the CTS or a study on the holistic effect is not found in the literature.

It is seen in both individual studies and in this meta-analysis study that students' CTS increase in a classroom where SCA are used. However, in the moderator analysis conducted to reveal which approaches and methods are more effective, it is seen that approaches and methods that have the most effect among SCA on students' CTS are respectively; storyline, active learning, six thinking hats, brain-based learning, game-based learning and creative drama. The common point of these approaches are that they provide individual and group work environment, develop multiple learning skills, and bring in skills such as collaboration, discussion and empathy. In the meta-analysis study conducted by Hsen-Hsing Ma (2009), it is seen that problem solving and communication skills stand out among the important variables that affect creativity. In this context, especially active learning, brain-based learning, creative drama and game/storyline methods can be considered meaningful in the context of having more of these two skills. On the other hand, the effects of research-inquiry based learning, argumentation, and cooperative learning approaches on students' CTS are slightly lower than other methods. In the meta-analysis study conducted by Ören and Sarı (2019), the effect of research-inquiry based learning on students' higher order thinking skills is moderate and positive (ES=0.66), while in this meta-analysis study, the effect on CTS which is among higher order thinking skills is insignificant and low. This may be due to the fact that there is the only one study included in the scope of meta-analysis (Şensoy & Yıldırım, 2017). Generally, it is seen that research, interaction and activity-based learning positively affect students' higher order thinking skills, especially CTS (Aktamış, Hiğde & Özden, 2016). The findings of this meta-analysis study also support this view. In the context of this meta-analysis study, it can be said that learning environments where approaches and methods such as constructivist approach, storyline, educational games, active learning and drama are applied, the opportunities offered to students have a positive effect students' CTS. In these learning

environments, students actively work (Aydın, 2011) make inquiries, scientific method process is applied, and in this way, many higher order thinking skills, especially scientific process skills (Karakuş & Yalçın, 2016), are developed (Perry & Karpova, 2017).

Another result obtained in the study is that in terms of education stage, students' CTS is higher in favor of SCA in preschool education stage. Theorists (Hertzog, 2008; Özçelik, 2019; Vygotsky, 2004) that deal with the developmental processes of CTS state that the creativity of younger children is more developable and they use these skills more to make sense of the world around them. In the study conducted by Yaşar and Aral (2010), the finding that preschool education stage has a high impact on students' CTS also supports the results of this meta-analysis study. In the study conducted by Krauksta, Rozenvalde and Ciekurs (2016); It is revealed that active learning approaches involving activities carried out in extra-curricular environments and storyline and game activities contributed to the development of CTS in the preschool education stage. In the study conducted by Atay (2009), it is stated that students in preschool education stage have higher level of CTS than students at other stages, and that other than the use of SCA, imagination, flexible thinking and learning speed/agility are also effective as a feature of their cognitive development period. These meta-analysis results reveal that students contribute more to the development of CTS compared to other education stages, especially in this stage where the activity-intensive learning-teaching process is carried out. As we move from preschool education to higher education, it is seen that students' CTS decrease. This situation can be explained by the increase in the effect of a teacher-centered and exam-oriented education approach in primary and secondary education stages and the less use of SCA. However, the developmental process does not follow a linear rise in the context of creativity, it is stated that there is a collapse in CTS after the 4th grade (Hong & Milgram, 2010; Raina, 1980; Torrance, 1968). In addition, it is known that the students in the upper classes get higher scores in creative thinking than the students in the lower grades among classes 1 to 5 (Hong & Milgram, 2010; Sak & Maker, 2006). Due to this developmental difference in creativity skills, it is thought that in this meta-analysis stud, results are in favor of preschool students. In addition, the finding that preschool teachers have high creative thinking tendencies in the study conducted by Eskidemir and Tezel (2019) supports the results of this meta-analysis study. In a sense, this can be evaluated as that the attitudes of the teachers are important in the development of the students.

In terms of scale type, Whetton and Cameron (2002) Creative Thinking Skill Scale "How Creative Are You?" which is used in 19 studies and The Torrance (1966) Creative Thinking Test scale “Test of Creative Thinking” used in 65 studies produced similar results. In the literature, it is seen that these two scales are often used to measure CTS in the world and in Turkey and that the validity/reliability is higher (Çetin, Üstündağ, Kerimoğlu and Beyazıt, 2015, Kim, 2011). It is seen that the effect size of the studies using these two scales (ES=0.70-0.79) is very close to the effect size found in this meta-analysis study (ES=0.73). However, there are significant differences between other scales in terms of effect sizes. In addition to the valid/reliable scales that measure students' CTS in a way that matches the results of the study, it is also seen that different measurement tools give results that are not close to each other (Carson, Peterson & Higgins, 2005; Dollinger, Urban & James, 2004; Haasse et al., 2018).

When the gender of the researcher is female, it is seen that the students' CTS are higher in favor of SCA. This can be explained by the fact that only 26 of the 104 studies included in the meta-analysis study are done by male researchers and that female researchers have more interest and motivation for learning and studying on this subject. In addition, the fact that studies in the preschool education stage and studies where the students have higher CTS are carried out by female researchers can be effective in this.

In terms of the moderator variable, it is observed that the students are more likely to increase their CTS when SCA are applied in lessons in preschool education stage and Social Studies, Philosophy, Assesment and Evaluation, Turkish, Mathematics and Visual Arts lessons in different education stages. Since teacher centered approaches and methods are generally used in these lessons, it is clear that when SCA are applied, it will contribute more to the development of higher order thinking skills of students (Perry & Karpova, 2017; Weimer, 2002). As an interesting result, it is observed that the application of SCA does not have any effect on students' CTS in geography lessons. Geography lessons in Turkey are carried out with many concepts taught with a complex structure (Akbulut, 2004). Although student centered approaches are tried to be used, it is difficult to increase creativity in schools without geography laboratories (Gardner et al., 1997; as cited in Akbulut, 2004). This interesting result of the study is thought to have originated from the conditions in which Geography lessons are carried out in Turkey.

It is determined that the effect size of the studies does not differ according to publication type, student group (normal-gifted), school type (state, foundation, science and arts center) and region of the study. Since no meta-

analysis studies that reveal the effect of SCA on students' CTS carried out in Turkey and abroad are found, it is impossible to compare results.

Furthermore, it is seen that the positive effect of SCA used in lessons on students' CTS continues within years of which meta-analysis studies are carried out (1990-2020). The adoption of the constructivist approach in the education programs in Turkey since 2005 has increased interest in the higher order thinking skills such as CTS. Therefore, the research carried out in Turkey dealing with CTS is known to increase in numbers after 2005 (Saracaloğlu et. al., 2014).

Recommendations

Recommendations for Researchers

- In the context of the results of this meta-analysis study, meta-analysis studies can be conducted by using variables that have effect on students' CTS other than SCA applications such as teacher quality, school culture, out-of-school activities, family and social environment.
- In the context of the results of this meta-analysis study, it can be suggested to make qualitative and quantitative studies on the factors that may have effect on students' CTS. Studies can be conducted to determine the effects of SCA on higher order thinking skills other than CTS (problem solving, meta-cognitive thinking etc.).
- It can be suggested to make meta-synthesis studies on the factors that may have effect on students' CTS.
- It can be suggested to make research conducted outside the Turkey in order to compare and to generalize the findings of the meta-analysis.

Recommendations for Implementers

- As a result of the meta-analysis study, it is observed that the learning-teaching approaches such as storyline, active learning, six thinking hats, brain-based learning, game-based learning and creative drama are more effective on students' CTS than other approaches. In this context, it can be suggested that teachers use these approaches more in the lessons for the development of students' CTS. In addition, it can be suggested to use more of SCA and activities that develop students' CTS in primary and secondary education.
- It can be suggested to use teaching methods and techniques based on social interaction in cognitive sense in order to develop students' creative thinking skills.

References

(The symbol of * refers to the studies included in the meta-analysis).

*Akar, İ., & Şengil Akar, Ş. (2013). The effectiveness of the creative reversal act (creact) on students' creative thinking: further evidence from Turkey. *The Turkish Online Journal of Educational Technology,* 12(4), 183-191.

Akbulut, G. (2004). Geography teaching and creative thinking. *C.Ü. Sosyal Bilimler Dergisi*, 28(2), 215-223.

Akkaya, M. (2019). *The effects of research inquiry-based teaching on scientific process skills: A national meta analysıs study.* Ağrı İbrahim Çeçen University. Master Dissertation, Institute of Science, Ağrı.

*Akkılıç, G. (2018). *Investigation of the effect of activities based on six thinking hats technique in a philosophy class on creativity, critical thinking and academic self-efficacy.* Atatürk University. Master Dissertation, Institute of Educational Sciences, Erzurum.

*Akran, K. S., & Aşıroğlu, S. (2018). The effect of writing circle technique on prospective teachers' creative thinking skills. *Inonu University Journal of the Graduate School of Education*, 5(10). *Aksoy, M. (2018). Investigation of the effects of block play on children's creativity. Gazi University, Master Dissertation, Institute of Educational Sciences, Ankara.

Aktamış, H., Hiğde, E., & Özden, B. (2016). Effects of the ınquiry-based learning method on students' achievement, science process skills and attitudes towards science: a meta-analysis science. *Journal of Turkish Science Education*, 13(4), 248-261.

*Akyürek Tay, B. (2019). *The effect of patterned case method with band caricatures on success, permanence and creative thinkıng skills in social studies course.* Gazi University, PhD Dissertation, Institute of Educational Sciences, Ankara.

*Altındağ, C., Göksel, Ç., Koray, Ö., & Koray, A. (2012). *The effect of science and technology laboratory applications based on critical and creative thinking on problem solving and creativity.* X.Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi. Niğde: Türkiye (27-30 Haziran 2012)

*Aras, R. (2018). *Secondary school 6. grade social studies in problem based learning approach the effect of higher-order thinkıng skills and creativity level.* Erzincan Binali Yıldırım University, Master Dissertation, Institute of Social Sciences, Erzincan.

*Arkan Sezgin, K. & Baysal, Z. N. (2019). Examining the effects of thinking skills program developed for the primary school 3rd-grade students on their creativity levels. *HAYEF: Journal of Education,* 16(1); 19-47.APA (1997). *Learner-centered psychological principles: A framework for school redesign and reform.* Retrieved from https://www.apa.org/ed/ governance/bea/learner-centered.pdf.

Arık, S. & Yılmaz, M. (2020). The effect of constructivist learning approach and active learning on environmental education: A meta-analysis study. *International Electronic. Journal of Environmental Education,* 10(2), 44-84.

Aşık, Z., & Özen, M. (2019). *Meta-Analysis Steps and Reporting. Turkish Journal of Family Medicine and Primary Care*, 13(2), 232-240.

Atay, Z. (2009). *Okul öncesi eğitim kurumlarına devam eden 5-6 yaş öğrencilerinin yaratıcılık düzeylerinin yaş, cinsiyet ve ebeveyn eğitim durumlarına göre incelenmesi [Investigation of the creativity levels of 5-6 year old students attending preschool education ınstitutions according to age, gender and parental education status],* Master Dissertation, Selçuk University, Konya

*Atalay, Z. Ö. (2014). *The effect of differentiated social studies instruction on gifted students' academic achievement, attitudes, critical thinking and creativity.* Istanbul University, PhD Dissertation, Institute of Educational Sciences, Istanbul.

*Avcu, Y. E. (2014). *The effect of creative thinking activities on students' creative thinking and academic achievement "Geography Lesson Example".* Çanakkale Onsekiz Mart University. Master Dissertation, Institute of Educational Sciences, Çanakkale.

Ayaz, M. F. (2014). *The effect of the project-based learning approach on the academic achievements of the students in science lesson and their attitudes towards science lesson: A meta-analysis study.* Dicle University. PhD Dissertation, Institute of Educational Sciences, Diyarbakır.

Ayaz, M. F. (2015). The effect of 5E learning model on the attitudes towards lessons of the students: A meta-analysis study. *Electronic Journal of Education Sciences.* 4(7), 29-50.

Ayaz, M. F. & Şekerci, H. (2016). The effect of constructivist learning approach to attitudes of the students towards lessons: A meta-analysis study. *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi,* 47, 46-63. Retrieved from https://dergipark.org.tr/tr/pub/dpusbe/issue/26801/286166

*Aydın, Z. (2011). *The effects of active learning activities on the 6th graders' attitude towards mathematics classes and their creative thinking abilities.* Gaziantep University, Master Dissertation, Institute of Social Sciences, Gaziantep.

*Bacak, S. (2008). *The effect of story-based learning approach on academic success and creativity of 5th grade social sciences course.* Celal Bayar University, Master Dissertation, Institute of Social Sciences, Manisa.

Bakioğlu, A. & Özcan, Ş. (2016). *Meta Analysis*. Ankara: Nobel Academy Publishing.

Baş, G. (2016). The effect of multiple intelligences theory-based education on academic achievement: A meta-analytic review. *Educational Sciences: Theory & Practice*, 16, 1833–1864.

*Başkök, B. (2012). *Investigation of the effect of creative writing studies on the seven grade students on the creativities and attitude of Turkish courses.* Akdeniz University, Master Dissertation, Institute of Social Sciences, Antalya.

Başol, G., Doğuyurt, M. F., & Demir, S. (2016). A content analysis and methodological evaluation of meta-analyses on Turkish samples. *International Journal of Human Sciences*, 13(1), 714-745.

*Batdal Karaduman, G. (2012). *The effect of differentiation geometry teaching on creative thinking, spatial ability level and access for primary school 5th grade gifted students.* Istanbul University, PhD Dissertation, Institute of Social Sciences, Istanbul.

Batdı, V. (2014). The effect of activity-based learning approach on academic achievement (A meta-analytic and thematic study). *e-International Journal of Educational Research*, 5(3), 39-55.

Batdı, V. (2014b). The effect of blended learning environments on students' academic achievement: a meta-analysis study. *Çankırı Karatekin Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 5(1), 287-302.

*Baylav Korkmaz, H. (2002). *The effect of project based learning on creative thinking, problem solving and academic risk taking levels in science education.* Hacettepe University, PhD Dissertation, Institute of Social Sciences, Ankara.

*Baz, B. (2019). *The effect of the program based on the children's literature texts on the creative thinking skills of primary school students.* Yıldız Teknik University, Master Dissertation. Institute of Social Sciences, İstanbul.

Becker, K & Park, K. (2011). Effects of integrative approaches among science, technology, engineering, and mathematics (STEM) subjects on students' learning: A preliminary meta-analysis. *Journal of STEM Education*, 12(5/6), 23-37.

Beghetto, R. A. (2016). Creative learning: A fresh look. *Journal of Cognitive Education and Psychology*, 15, 6–23.

Belland, B. R., Walker, A. E., Kim, N. J., & Lefler, M. (2017). Synthesizing results from empirical research on computer-based scaffolding in STEM education: A meta-analysis. *Review of Educational Research*, *87*(2), 309-344.

*Biber, M. (2006). *The effect of the discovering learning method on the creativity of elementary school students of 2nd stage mathematics course.* Dokuz Eylül University, Master Dissertation, Institute of Educational Sciences, İzmir.

Biçer, N. (2017). The influence of student-centered methods in Turkish language instruction on academic success: A meta-analysis study. *Universal Journal of Educational Research,* 5(4), 687-69.

*Birinci, E. (2008). *The effect of using project-based learning in adaptation and development of materials on teacher candidates' critical thinking, creative thinking and scientific-process skills.* Zonguldak Karaelmas University, Master Dissertation. Institute of Social Sciences, Zonguldak.

*Birişçi, S. & Karal, H. (2011). Effect of collaborative studies on prospective teachers' creative thinking skills while designing computer based material. *Ahi Evran Üniversitesi Eğitim Fakültesi Dergisi*, 12(2/Haziran), 203-219.

Blumberg, P. (2008). *A guide to learner-centered teaching*. San Francisco: Jossey-Bass.

Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2009). *Introduction to meta-analysis*. West Sussex-UK: John Wiley & Sons Ltd.

Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2013). *Meta-Analize Giriş*. Çev. Serkan Dinçer, Ankara: Anı Yayıncılık.

Brown, K. L. (2003). From teacher-centered to learner-centered curriculum: Improving learning in diverse classrooms. *Education,* 124(1), 49-54.

Brown, M. N. & Freeman, K. (2000). Distinguishing features of critical thinking classrooms. *Teach. Higher Educ*. 5(3), 301-309.

*Bulut, D. (2015). *The effect of educational game design process on student's creativity.* Bahcesehir University, Master Dissertation, Institute of Educational Sciences, İstanbul.

*Camcı Erdoğan, S. (2014). *The effect of differentiated science and technology instruction based on scientific creativity on gifted and talented students' achievement, attitude and creativity.* Istanbul University, PhD Dissertation, Institute of Educational Sciences, Istanbul.

Camnalbur, M. & Mutlu Bayraktar, D. (2018). The effect of collaborative learning on academic achievement: A meta-analysis study. *Journal of the Human and Social Sciences Researches,* 7(2), 1149-1172.

Cantürk Günhan, B. (2016). The effect of drama based learning applied in turkey on success of mathematics: a meta-analysis study. *International Online Journal of Educational Sciences,* 8(2), 145-162.

Capar, G. & Tarim, K. (2015). Efficacy of the cooperative learning method on mathematics achievement and attitude: A meta-analysis research. *Educational Sciences: Theory & Practice,* 15(2), 553-559.

Card, N. A. (2012). *Applied meta-analysis for social science research*. New York: The Guilford Press, 7, 9.

Carson, S. H., Peterson, J. B., & Higgins, D. M. (2005). Reliability, validity, and factor structure of the creative achievement questionnaire. *Creativity Research Journal*, 17, 37-50. DOI:10.1207/s15326934crj1701_4

Chung, N. & Ro, G. (2004). The Effect of problem-solving instruction on children's creativity and self-efficacy in the teaching of the practical arts subject. *The Journal of Technology Studies.* 30(2), 116-122.

Cohen, J. (1988). *Statistical power analysis for behavioral sciences* (2nd ed.).Hillsdale, NY: Lawrence Erlbaum Associates.

Cohen, J. (1992). Statistical power analysis. *Current Directions in Psychological Science*, 1 (3), 98-101.

Cooper, H. M. (2009). *Research synthesis and* meta-analysis*: A step-by-step approach* (4th ed.). Thousand Oaks, CA: Sage Publications.

Cruz, R. E., Lian, M. J. & Morreau, L. E. (1998) The effects of creative drama on social and oral language skills of children with learning disabilities. *Youth Theatre Journal*, 12(1), 89-95. DOI: 10.1080/08929092.1998.10012498

Cumming, G. (2012). *Understanding the new statistics*. New York: Routledge, Taylor and Francis Group.

Çelik, S. (2013). *The effect of alternative teaching methods used in elementary mathematics classes on academic success: A meta analysis study*. Eskişehir Osmangazi University. Master Dissertation, Institute of Educational Sciences, Eskişehir.

Çetin, Z., Üstündağ, A., Kerimoğlu, G. & Beyazıt, U. (2015). Examining the assessment tools used for creativity of children in Turkey and worldwıde. *H.Ü. Sağlık Bilimleri Fakültesi Dergisi*, 2(2), 30-49.

*Çetinkaya, Ç. (2014). The effect of gifted students' creative problem solving program on creative thinking. *Procedia - Social and Behavioral Sciences*, 116(2014), 3722–3726.

Chiu, Y. H., Kao, C. W., & Reynolds, B. L. (2012). The relative effectiveness of digital game-based learning types in English as a foreign language setting: A meta-analysis. *British journal of educational technology*, *43*(4), E104-E107.

Çırak-Kurt, S., Yıldırım, İ. & Cücük, E. (2018). The effects of blended learning on student achievement: a meta-analysis study. *H. U. Journal of Education*, 33(3), 776-802.

*Çoban, B. (2014). *The effects of problem based learning to success, creativity and transfer skills of the students.* Gazi University, Master Dissertation, Institute of Educational Sciences, Ankara.

*Çolakoğlu, S. (2018). *The effect of the teaching of the circle topic on the creative thinking skills of 7th grade students with the geogebra software*. Bayburt University, Master Dissertation, Institute of Social Sciences, Bayburt.

Dağyar, M. (2014). *The effects of problem based learning on academic achievement: A meta-analysis study.* Hacettepe University. PhD Dissertation, Institute of Educational Sciences, Ankara.

Darsih, E. (2018). Learner-centered learning: What makes it effective. *Indonesian EFL Journal,* 4(1), 33-42. DOI: 10.25134/ieflj.v4i1.796.

Demir, S. & Başol, G. (2014). Effectiveness of computer-assisted mathematics education (came) over academic achievement: A meta-analysis study. *Educational Sciences: Theory & Practice,* 14(5), 2026-2035.

*Dere, Z. & Ömeroğlu, E. (2018). A study on the effects of creativity training program on creative behaviors of children. *Cumhuriyet International Journal of Education,* 7(1), 1-15. Doi:10.30703/cije.333901.

Dinçer, S. (2014). *Eğitim bilimlerinde uygulamalı meta-analiz*. Ankara: PEGEM Akademi Yayıncılık.

Dochy, F., Segers, M., Bossche, P. & Gijbels, D. (2003). Effects of problem-based learning: a meta-analysis. *Learning and Instruction*, 13(5), 533-568.

Doğan, N. (2005). Creative thinking. Demirel Ö. (Ed.*), New Trends in Education* (2. Edition). Ankara: Pegem A.

Dollinger, S. J., Urban, K. K., & James, T. A. (2004). Creativity and openness: Further validation of two creative product measures. *Creativity Research Journal*, 16, 35-47.

Drapeau, P. (2014). *Sparking Student Creativity: Practical Ways to Promote Innovative Thinking and Problem Solving*. ASCD Learn Teaching.

*Düzen, Ü. (2019). *The effect of mathematical centered stem activities on the creative thinking skills of students and ınvestigation of student opinions.* Bayburt University, Master Dissertation, Institute of Social Sciences, Bayburt.

*Ekinci Işık, D. (2007). The effect of project based learning on academic success, creative thinking, permanance attitude levels towards life study course in knowledge of life teaching. Dokuz Eylül University, Master Dissertation, Institute of Educational Sciences, İzmir.

Ellis, P. D. (2012). *The essential guide to effect sizes* (5th edition). Cambridge-UK: Cambridge University Press.

*Engin, G. A. (2019). *The effect of integrated creative drama-art activities applied to 4-5 years old pre-school children on creative thinking skills.* Ankara University, Master Dissertation, Institute of Educational Sciences, Ankara.

Erdamar, G., Ayataç, T., Demir, E. & Demir, F. (2015). The Effects of Constructivist Learning Approach on Academic Success of Students: A Meta-Analysis. Education in the 21st Century: Theory and Practice, St. Kliment Ohridski University Pres.

Erden, H., Aytaç, T. & Erden, A. (2016). *Effect of Creative Drama on Students' Academic Achievement: A Meta-Analysis Study*. 2nd International Conference on Lifelong Education and Leadership for All, ICLEL 2016, July 21-23, 2016, Sakarya University&Liepaja University, Liepaja-LATVIA.

*Ersoy, E. & Başer, N. (2014). The effects of problem-based learning method in higher education on creative thinking. *Procedia-Social and Behavioral Sciences,* 116(2014) 3494-3498.

Eskidemir, M. S. & Tezel, Ş. F. (2019). Creative thinking dispositions of the preschool teachers. *OPUS Uluslararası Toplum Araştırmaları Dergisi*, 13 (19) , 311-331.

*Eşsizoğlu, G. (2013). *The effect of project based learning in social sciences on gifted students' achievement, critical thinking and creativity.* Istanbul University, Master Dissertation, Institute of Educational Sciences, İstanbul.

Furtak, E. M., Seidel, T., Iverson, H., & Briggs, D. C. (2012). Experimental and quasi-experimental studies of inquiry-based science teaching: A meta-analysis. *Review of educational research*, *82*(3), 300-329.

Gajda, A., Karwowski, M., & Beghetto, R. A. (2017). Creativity and academic achievement: A meta-analysis. *Journal of Educational Psychology, 109*(2), 269–299.

Galton, M., Hargreaves, L. & Pell, T. (2009). Group work and whole-class teaching with 11 to14 year olds compared. *Cambridge J. Educ*. 39(1), 119-140.

*Gizir Ergen, Z. (2013). *A study on the effects of the project approach on the creativity of children attending preschool.* Ankara University, PhD Dissertation, Institute of Science, Ankara.

*Gölcük, A. (2017). *The effect of science education that is supported by scıentıfic storıes on students' creatıvıty and affectıve properties.* Hacettepe University, Master Dissertation, Institute of Educational Sciences, Ankara.

Gözüyeşil, E. & Dikici, A. (2014). The effect of brain based learning on academic achievement: A meta-analytical study. *Educational Sciences: Theory & Practice*, 14(2), 642-648.

*Güldemir, S. (2019). *The effect of stem activities on creativity in pre-school education.* Recep Tayyip Erdoğan University. Master Dissertation, Institute of Science, Rize.

*Günbatar, M. S. (2009). *The effect of web-assisted problem-based learning on students 'creative thinking skills and attitudes.* Yüzüncü Yıl University, Master Dissertation, Institute of Social Sciences, Van.

* Gündoğan, A., Arı, M. & Gönen, M. (2013). The effect of drama on the creative ımagination of children in different age groups. *Hacettepe University Journal of Education*, 28(2), 206-220.

*Güner Yüksel, S. (2019). *The effect of problem based learning method on students 'creative thinking and problem solving skills and academic achievements in social studies.* Gaziantep University. Master Dissertation, Institute of Educational Sciences, Gaziantep.

Haase, J., Hoff, E. V., Hanel, P. H. P. & Innes-Ker, A. (2018) A meta- analysis of the relation between creative self-efficacy and different creativity measurements. *Creativity Research Journal,* 30(1), 1-16.

*Hacıoğlu, Y. (2017). *The effect of science, techology, engineering and mathematics (stem) education based activities on prospective science teachers' critical and creative thinking skills.* Gazi University, PhD Dissertation, Institute of Educational Sciences, Ankara.

Hartung, J., Knapp, G., & Sinha, B. K. (2008). *Statistical meta-analysis with applications*. New Jersey: Wiley Publishing Inc.

Hertzog, N. B. (2008). *Ready for preschool*. Prufrock Press, Waco: TX.

*Hızır, B. (2014). *The effect of creative reading to creative thinking skill in primary and secondary school.* Muğla Sıtkı Koçman University. Master Dissertation, Institute of Educational Sciences, Muğla.

Higgins, J. P., Thompson, S. G., Deeks, J. J., Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *Bmj*. 327(7414), 557-60.

Hong, E. & Milgram, R. M. (2010) Creative thinking ability: Domain generality and specificity, *Creativity Research Journal*, 22(3), 272-287. DOI: 10.1080/10400419.2010.503535

Hsen-Hsing Ma (2009). The Effect Size of Variables Associated with Creativity: A Meta-Analysis. *Creativity Research Journal*, 21:1, 30-42.

Huedo-Medina, Tania; Sanchez-Meca, Julio; Marin-Martinez, Fulgencio; and Botella, Juan (2006). Assessing heterogeneity in meta-analysis: Q statistic or I2 index?". *CHIP Documents*. 19.

Internet: Prisma Checklist Turkish Version. WEB: Retrieved from http://www.prismastatement.org/documents/PRISMA%20Turkish%20checklist.pdf

*Işık, A. D. & Saygılı, G. (2015). The effect of learning creative development techniques on the skills of creative thinking. *Bartin University Journal of Faculty of Education*, Special Issue on XIV. International Participation Symposium of Primary School Teacher Education (21-23 May, 2015), 133 – 139.

*İkikat, U. (2019). *The effect of enriched science course on the creative thoughts of primary school students.* İstanbul Aydın University, Master Dissertation, Institute of Social Sciences, İstanbul.

*İşeri, Ş. (2010). *Effect of class activities based on newspapers used in science and technology lessons on the attitude and creativity of students.* Kocaeli University. Master Dissertation, Institute of Science, Kocaeli.

Johnson, D. W., Johnson, R. T. & Stanne, M. B. (2000). *Cooperative learning methods: A meta-analysis.* University of Minnesota, Minneapolis, Minnesota.

*Kanlı, E. & Emir, S. (2013). The Effect of problem based learning on gifted and normal students' achievement and creativity levels. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education,* 7(2, December), 18-45.

Kaplan, A., Duran, M. & Baş, G. (2015). The effects of ınstruction based on multiple ıntelligence theory in mathematics course on academic achievement: A meta-analysis study. *Mersin University Journal of the Faculty of Education,* 11(3): 814-831.

*Kaplan Sayı, A. (2013). *The effect of differentiated foreign language instructıon on gifted students' achievement, critical thinking and creativity.* Istanbul University, PhD Dissertation, Institute of Social Sciences, Istanbul.

*Kar, T. (2010). *The effects of problem-based learning in linear algebra on the academic achievement, problem-solving skills and creativity of students.* Atatürk University, Master Dissertation, Institute of Science, Erzurum.

*Karaca, T. & Koray, Ö. (2017). The Effect of using the creative reversal act in science education on middle school students' creativity levels. *Euraisan Journal of Educational Research.* 67, 199-214. http://dx.doi.org/10.14689/ejer.2017.67.12

*Karadayı, Ş. İ. (2018). *The effect of creative education on preschool period on creative performance, administrative mental functions and emotional regulatory skills.* Ege University. Master Dissertation, Institute of Social Sciences, İzmir.

*Karakuş, M. (2000). *The effects of creative problem solving curriculum on the creativity levels of creativity in the second grade students who are from low socio-economic status.* Cukurova University, Master Dissertation, Institute of Social Sciences, Adana.

Karakuş, M. & Yalçın, O. (2016). The effect of the argümantation-based learning in science education to the academic achievement and scientific process skills: A meta analysis study. *Anadolu University Journal of Social Sciences*, 16(4), 1-20.

*Karataş, S. & Özcan, S. (2010). The effects of creative thinking activities on learners' creative thinking and project development skills. *Ahi Evran Üniversitesi Eğitim Fakültesi Dergisi,* 11(1), 225-243.

*Karataş Öztürk, S. (2007). *The effect of the learning approach based on creative thinking upon the creative thinking and problem solving skills of students.* Eskişehir Osmangazi University, Master Dissertation, Institute of Science, Eskişehir.

Kaşarcı, İ. (2013). *The effectiveness of project based learning on students' academic achievements and attıtude: A meta-analysis.* Eskişehir Osmangazi University. Master Dissertation, Institute of Educational Sciences, Eskişehir.

Kaya, A. & Öçal, M. F. (2018). A meta-analysis for the effect of geogebra on students' academic achievements in mathematics. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education*, 12(2), 31-59.

*Kaya, H. İ. (2010). *Effects of the practices based on constructivist learning in teacher education on teacher candidates' tendencies of problem solving, critical thinking and creative thinking.* Atatürk University, PhD Dissertation, Institute of Social Sciences, Erzurum.

*Kaya, M. E. (2018). *Effects of stem applications on scientific arrangement and creativity of science teachers of science.* Erzincan Binali Yıldırım University. Master Dissertation, Institute of Science, Erzincan.

*Kıncal, R. Y., Avcu, Y. E. & Kartal, O. Y. (2016). The effects of creative thinking activities on learners' creative thinking skills and academic achievement. *Journal of Theoretical Educational Science,* 9(1), 15-37.

Kim, K. H. (2005). Can only intelligent people be creative? A meta-analysis. Journal of Secondary Gifted Education. 16(2-3), 57-66.

Kim, K. H. (2011). (2011). The creativity crisis: The decrease in creative thinking scores on the torrance tests of creative thinking. *Creativity Research Journal*, 23, 4, 285-295.

*Koray, Ö. (2004). The influence of science education based on creative thinking on creativity of preservice teachers. *Educational Administration in Theory & Practice,* Fall (40), 580-599.

* Koray, Ö. & Köksal, M. S. (2009). The effect of creative and critical thinking based laboratory applications on creative and logical thinking abilities of prospective teachers. *Asia-Pacific Forum on Science Learning and Teaching,* 10(1), 3-13.

*Kök, B. (2012). *The effect of differentiated geometry teaching on gifted and talented students in view of creativity, spatial ability and success.* Istanbul University, PhD Dissertation, Institute of Social Sciences, Istanbul.

*Köse Biber, S. (2014). *The effect of web-based learning supported by creativity improving activities on students' achievement and creativity.* Istanbul University, PhD Dissertation, Institute of Science, Istanbul.

Krauksta D., Rozenvalde, P. & Ciekurs, K. (2016). Outdoor Activities to Promote Creative Thinking in Preschool Children. *Society, Integration, Education* Proceedings of the International Scientific Conference. Volume II, May 27th - 28th, 2016. 396-403.

Kuo, F.R., Chen, N. S. and Hwang, G. J. (2014). A creative thinking approach to enhancing the web-based problem solving performance of university students. *Computers & Education*. Vol. 72, 220-230.

*Kuytan, Ş. (2019). *The effect of individual or group educational game development on pre-service teachers' creative thinking.* Mersin University, Master Dissertation, Institute of Educational Sciences, Mersin.

Kylonen, P. C. (2012). Measurement of 21st century skills within the common core state standards. Paper presented at the Invitational Research Symposium on Technology Enhanced Assessments, May 7-8.

Lee, B. K., Patall, E. A., Cawthon, S. W., & Steingut, R. R. (2015). The effect of drama-based pedagogy on preK–16 outcomes: A meta-analysis of research from 1985 to 2012. *Review of Educational Research*, *85*(1), 3-49.

Li, Q. & Ma, X. (2010). A meta analysis of the effects of computer technology on school students' mathematics learning. *Educational Psychology Review*, 22, 215-243.

Littell, J. H., Corcoran, J. and Pillai, V. (2008). *Systematic reviews and meta-analysis*. UK: Oxford University Press.

MEB. (2018). *2023 Eğitim Vizyonu Belgesi*. Retrieved from http://2023vizyonu.meb.gov.tr/ 11.01.2019.

Merchant, Z., Goetz, E. T., Cifuents, L., Keeney-Kennicutt, W. & Davis, T. J. (2014). Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis. *Computers & Education,* 70, 29-40.

*Metin, Ö. (2019). *The effect of music story and tales on the creativity levels of children in pre-school education.* Marmara University, Master Dissertation, Institute of Educational Sciences, İstanbul.

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

Okursoy-Günhan, F. (2009). The effect of concept mapping on learner success: A meta-analytic study. Marmara University. Master Dissertation, Institute of Educational Sciences, İstanbul.

*Orçan, A. (2013). *The effect of science-fiction stories developed by comics technique, on creative thinking skills and physics attitudes of students.* Gazi University, Master Dissertation, Institute of Educational Sciences, Ankara.

*Öç, U. (2019). *Scientific process skills of science lab applications based on argumentation, their effects on the attitude for laboratory and the creativity.* Sivas Cumhuriyet University, Master Dissertation, Institute of Educational Sciences, Sivas.

*Ömeroğlu, E. (1990). *The effect of creative drama education on the development of verbal creativity of 5-6 year old children who attend kindergarten*. Hacettepe University, PhD Dissertation, Health Sciences Institute, Ankara.

Özbey, Ö. F. & Sarıkaya, R. (2019). Investigation of effectiveness on drama method studies in Turkey: A meta-analysis study. *Gazi Journal of Education Sciences (GJES),* 5, Özel Sayı, 231-253.

*Özcan, E. (2019). *Investigation of the effects of argumentation based science learning approach on the conceptual understanding of the students, their creative thought and the epistemological beliefs*. Marmara University, Master Dissertation, Institute of Educational Sciences, İstanbul.

Özçelik, A. D. Ö. (2019). *Eğitimde ve Endüstride 21. Yüzyıl Becerileri*. Editörler: Prof. Dr. Ayşe Dilek Öğretir Özçelik ve Dr. Öğr. Üyesi Mehmet Nur Tuğluk, 2. Baskı, Ankara: Pegem Akademi.

Özdemir, F., Aslaner, R. & Açıkgül, K. (2020). The effect of the computer-aided mathematics teaching on the students' attitudes towards mathematics: A meta - analysis study. *Inonu University Journal of the Graduate School of Education,* 7(13), DOI: 10.29129/inujgse.543534.

*Özdemir, S. M. & Çakmak, A. (2008). The effect of drama education on prospective teachers' creativity. *International Journal of Instruction*, 1(1), 13-30.

*Özgenel, M., Canpolat, Ö., Yağan, E. & Canlı, Ö. (2019). The effects of enriched workshop training given to pre-school students on creative thinking skills of students. *Problems of Education in the 21st Century,* 77(5), 616-635.

*Özyaprak, M. (2012). *The effect of different mathematics teaching on his, attitude and creativity for the gifted and talented students.* Istanbul University, PhD Dissertation, Institute of Social Sciences, Istanbul.

*Palamut, İ. (2008). *Effects of reading story on primary students creativity and academical success.* Dokuz Eylül University, Master Dissertation, Institute of Educational Sciences, İzmir.

Pascarella, E. T., Wang, J. S., Trolian, T.L. & Blaich, C. (2013). How the instructional and learning environments of liberal arts colleges enhance cognitive development. *Higher Educ.* 66, 569-583.

Perry, A. & Karpova, E. (2017). Efficacy of teaching creative thinking skills: A comparison of multiple creativity assessments. *Thinking Skills and Creativity*. 24(2017), 118–126.

Peterson, M. (2010). Computerized games and simulations in computer-assisted language learning: A meta-analysis of research. Simulating & Gaming, 41(1), 72-93.

Petticrew, M., & Roberts, H. (2006). *Systematic reviews in the social sciences*. MA- USA: Blackwell Publishers Ltd.

Runco, M. A. & Chand, I. (1995). Cognition and creativity. *Educational Psychology Review*, 7(1), 243-26.

*Sak, U & Öz, Ö. (2010). The effectiveness of the creative reversal act (CREACT) on students' creative thinking. *Thinking Skills and Creativity,* 5(2010), 33–39.

Saracaloğlu, A. S., Gündoğgu, K., Altın, M., Aksu, N., Kozağaç, Z. B. & Koç, B. (2014). Analysis of articles published in the field of creative thinking skills after the year of 2000. *Adnan Menderes Üniversitesi Eğitim Fakültesi Eğitim Bilimleri Dergisi,* 5(2), 62-74.

*Sarmaşık Kaya, G. (2018). *Research regarding the effects of "effective thinking training" program on the ninth grade students" problem solving and creative thinking abilities.* İstanbul University, Master Dissertation, Institute of Educational Sciences, İstanbul.

Sawyer, R. K. (2012). *Explaining creativity: The science of human innovation* (2nd ed.). New York, NY: Oxford University Press.

*Sevgen, M. (2016). *The effect of social skills education given to children through creative drama on the social development and creativity of kindergarten children.* İstanbul Sabahattin Zaim University, Master Dissertation, Institute of Social Sciences, İstanbul.

*Siper Kabadayı, G. (2019). *The effects of robotic activities on pre-school children's creative thinking skills.* Hacettepe University, Master Dissertation, Institute of Educational Sciences, Ankara.

*Sönmez, B. (2016). *The effect of thinking training lesson on 6th grade elemantary school students' critical and creative thinking skills.* Anadolu Universty, PhD Dissertation, Institute of Educational Sciences, Eskişehir.

*Sözer Çapan, A. (2014). *Investigation of the effect of a 5-year children's creative skills of a training program prepared by the brain based learning approach*. Marmara Universty, PhD Dissertation, Institute of Educational Sciences, İstanbul.

Sternberg, R. J. (2003). Creative thinking in the classroom. *Scandinavian Journal of Educational Research,* 47(3), 325-338. DOI: 10.1080/00313830308595

*Şener, N., Türk, C. & Taş, E. (2015). Improving science attitude and creative thinking through science education project: a design, implementation and assessment. *Journal of Education and Training Studies,* 3(4), 57-67.

*Şendağ, S. & Erol, O. (2015). Use of 3D drawing software in promoting creativity in preschool. *Journal of Theoretical Educational Science*, 8(3), 316-336.

*Şensoy, Ö. & Yıldırım, H. İ. (2017). The Effect of research investigation based learning approach on creative thinking and scientific process skills. *Cumhuriyet International Journal of Education-CIJE*, 6(1), 34 – 46.

*Tedik, G. (2013). *The effect of creative drama activities in the fourth grade of prımary school on creatıvıty abilities of students.* Atatürk University, Master Dissertation, Institute of Educational Sciences, Erzurum.

*Terzi, H. (2019). *The effects of intelligence games on the creative thinking skills of 6th grade students*. Bayburt University. Master Dissertation, Institute of Social Sciences, Bayburt.

*Tezci, E. (2002). *The effects of cunstructivist instructional design on the success and creativity of fifth-year students in primary schools.* Fırat University, PhD Dissertation, Institute of Social Sciences, Elazığ.

Torrance, E. P. (1966). *Torrance test of creative thinking*. Bensenville, IL: Scholastic Testing Service

Trilling, B. & Fadel, C. (2009). *21st century skills: Learning for life in our times*. Francisco: Jossey-Bass.

*Tut, E. (2018). *Effect of game-based learning applications in 4th grade science class on students' academic achievement and creative thinking skills.* Ondokuz Mayıs University. Master Dissertation, Institute of Educational Sciences, Samsun.

Tutal, Ö., Kaçire, İ. & Atabey, E. (2016). *Öğretmen eğitiminde kullanılan alternatif öğretim yöntemlerinin akademik başarıya etkisi: Bir meta-analiz çalışması.* 4. Uluslararası Eğitim Programları ve Öğretim Kongresi, Antalya.

*Ulaş, A. H., Tedik, G. & Sevim, O. (2014). The effect of creative drama activities in the fourth grade of prımary school in Turkey on creativity levels of students. *A. Ü. Türkiyat Araştırmaları Enstitüsü Dergisi*, 52, 331-350.

Ulubey, Ö. (2018). The effect of creative drama as a method on skills: A meta-analysis study. *Journal of Education and Training Studies*, 6(4), 63-78.

*Umar, Ç. N. (2014). *The effects of differentiated curriculum with blended learning method on gifted students' academic achiecevement, critical thinking abilities and creative.* Istanbul University, PhD Dissertation, Institute of Educational Sciences, Istanbul.

*Uygun, D. (2017). *The effectiveness of creative reversal act on 7th grade students' creative thinking.* Eskişehir Anadolu University. Master Dissertation, Institute of Educational Sciences, Eskişehir.

*Uysal, M. E. (2009). *The effects of cooperative learning on access, critical thought and creativity skills in primary education Turkish course*. Dokuz Eylul University, PhD Dissertation, Institute of Educational Sciences, İzmir.

*Ülger, K. (2018). The Effect of Problem-Based Learning on the Creative Thinking and Critical Thinking Disposition of Students in Visual Arts Education. *Interdisciplinary Journal of Problem-Based Learning*, 12(1).

*Ülger, K. & İmer, Z. (2013). The effect of problem based learning (pbl) approach on students' creative thinking ability. *Hacettepe University Journal of Education*, 28(1), 382-392.

*Üret, A. (2019). *Effects of stem education on creativity levels of 5-year-old preschool children.* Yıldız Teknik University, Master Dissertation, Institute of Social Sciences, İstanbul.

Vanderbos, G. R. (2006). *APA Dictionary of Psychology*. Washington, DC: American Psychological Association.

Vygotsky, L. S. (2004). Imagination and creativity in childhood. *Journal of Russian and East European Psychology*, 42, 7–97.

Wang, J. R., Huang, B. Y., Tsay, R. F., Lee, K. P., Lin, S. W., & Kao, H. L. (2011). A Meta-analysis of inquiry-based ınstruction on student learning outcomes in Taiwan. *Asia-Pacific Education Researcher (De La Salle University Manila)*, *20*(3).

Wilson, D. B. (2009). Systematic coding. H. Cooper, L. V. Hedges ve J. C. Valentine (Ed.), *The handbook of research synthesis and meta-analysis* içinde (2. bs., s. 159-176). New York: Russell Sage Foundation.

World Economic Forum (2016). The 10 skills you need to thrive in the Fourth Industrial Revolution. Retrieved from https://www.weforum.org/agenda/2016/01/the-10-skills-you-need-to-thrive-in-the-fourth-industrial-revolution/ 09.04.2020

Yalçın, S. (2018). 21. Yüzyıl becerileri ve bu becerilerin ölçülmesinde kullanılan araçlar ve yaklaşımlar. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Dergisi*, 51(1), 183-201.

*Yaman, S. & Yalçın, N. (2005). Effectiveness on creative thinking skills of problem based learning approach in science teaching. *Elemantary-Online*, 4(1), 42-52.

*Yaman, Y. (2014). *Effects of brain based science teaching on gifted students' achievement, critical thinking, creativity and attitudes.* Istanbul University, PhD Dissertation, Institute of Educational Sciences, Istanbul.

*Yaprakdal, A. B. (2013). *The effect of teaching objects design on the critical, creative thinking and scientific process skills of the teacher candidates.* Marmara University, PhD Dissertation, Institute of Educational Sciences, Istanbul.

Yaşar, M. C. & Aral, N. (2010). The effects of early childhood education on creative thinking skills. *Kuramsal Eğitimbilim*, 3 (2), 201-209.

*Yaşar, M. C. & Aral, N. (2012). Drama education on the creative thinking skills of 61-72 months old pre-school children. *US-China Education Review*, 6(2012), 568-577.

*Yazıcı, E., Belen, H, B., Baydar, I. Y., Aksu, G. & Okutan, N. Ş. (2019). The effect of story based activities on children's creativity skills. *Adıyaman University Journal of Educational Sciences*, 9(2), 226-249.

Yeşilpınar Uyar, M. & Doğanay, A. (2018). The effect of student-centered strategies, methods and techniques on academic achievement: A meta-analysis study. *Mersin University Journal of the Faculty of Education.* 14(1), 186-209.

*Yıldırım, A. & Akman, B. (2020). The effects of creative problem solving activities on creativity of preschoolers. *Anadolu Journal of Educational Sciences International*, 10(1), 399-431.

Yıldırım, A. ve Şimşek, H. (2011). *Sosyal bilimlerde nitel araştırma yöntemleri [Qualitative research methods in the social sciences]*. Ankara: Seçkin Yayıncılık.

*Yıldırım, M. (2018). *The effect of context-based storyline method in science education on acadeiıc achievement, creativity and attitudes towards science.* Abant İzzet Baysal University, PhD Dissertation, Institute of Educational Sciences, Bolu.

*Yıldız, Z. (2012). The effect of project based learning approach to high school students' level of creative thinking, problem solving, taking academic risk. Gazi University, Master Dissertation, Institute of Educational Sciences, Ankara.

*Yılmaz, O. (2006). *Effects of project-based learning on students' academic achievement, creativity and attitudes in 7th grade social science lesson.* Zonguldak Karaelmas University, Master Dissertation, Institute of Social Sciences, Zonguldak.

*Yılmaz, R. M. (2014). *Effects of three dimensional storytelling developed with augmented reality technology on narrative skill and creativity.* Atatürk University, PhD Dissertation, Institute of Educational Sciences, Erzurum.

*Yiğit, E. Ö. & Erdoğan, T. (2008). The effect of studying method applied in the social science course on the creative thinking levels of primary school students. *Ç.Ü. Sosyal Bilimler Enstitüsü Dergisi,* 17(3), 399-416.

*Yurdakal, İ. H. (2019). The effects of creative reading practices on the skills of creative thinking. *PAU Journal of Education*, 47, 130-144.

*Yüksel, Y. B. (2018). *The impact of creativity education program for preschoolers on kids' creativity and audio reasoning.* Gazi University, Master Dissertation, Institute of Educational Sciences, Ankara.

Weimer, M. (2002). *Learner-Centered Teaching*. San Francisco: Jossey-Bass.