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The Effect of Graphic Organizers on Language Teaching and Learning Areas: A Meta-Analysis Study

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Abstract

The aim of this study is to analyze whether the graphic organizers have a significant effect on the students' success in language teaching and learning areas compared to traditional techniques. Accordingly, 70 experimental/quasi experimental studies in this area -which were conducted between 2000-2016- have been analyzed with meta-analysis method. The effect size of studies (Hedge g), the analysis of heterogeneity, publication bias and intervening variable have been conducted with Comprehensive Meta-Analysis v2.0 (CMA) statistics. The data obtained from the study have been interpreted within random effects model. As a result, it has been detected that graphic organizers have a wide effect size on academic success rather than traditional teaching methods (Hedge g=0,897; %95CI=0,784-1,011). In the analysis of the intervening variable, it has been found no significant difference in the effect size values according to certain study characteristics which include graphic organizer types, language learning areas, publication type in which the application has been reported, the field of study, education level and application time. The study is considered to be important because it synthesizes the experimental studies which examine graphic organizers' effect on the students' academic success in terms of listening, reading, writing, grammar and vocabulary/concept learning.

Keywords

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Introduction

Graphic organizers which are specifically designed for facilitating learning and instruction of the context are visual and spatial symbols which describe content, structure and the key conceptual relationships of the text using lines, arrows and circles (Darch & Eaves, 1986). Graphic organizers are tools which combine linguistic forms like words and phrases with non-linguistic forms like symbols and arrows which show relationships (Marzano, Pickering, & Pollock, 2001). Appearance of these tools is based on learning theories provided in "The Psychology of Meaningful Verbal Learning" published by Ausubel in 1963. Ausubel emphasizes the difference between rote learning and meaningful learning in this work. He asserts that rote learning enables keeping information in memory for a short time but it does not include integration of new information with the existing concepts (Novak & Canas, 2009).

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Knowledge which is not structured actively by the students, in other words, the knowledge which exists in memorized form in the learner's cognitive structure does not have an extensible and improvable quality. On the contrary, in meaningful learning, the emphasized issue is about the efforts of learners to unify new concepts and propositions in an active way. Therefore, an individual develops and enriches his/her cognitive structure (Novak & Canas, 2009). In Ausubel's theory, it is asserted that learners' cognitive structures organize new information hierarchically and higher level concepts subsume more specific concepts in their cognitive structures. In this theory, new information is actively internalized with the help of thinking systems by joining to existing information (Malone & Dekkers, 1984). New learning can occur and meaningful learning can only be produced when the new information is related to existing knowledge so as to become a part of a strong cognitive structure. Graphic organizers provide learners with a meaningful frame in order to relate new information to existing cognitive structure.

Studies conducted by Institute for the Advancement of Research in Education (IARE, 2003) prove that three cognitive learning theories which are "Dual Coding Theory", "Schema Theory", "Cognitive Load Theory" support using graphic organizers in learning process. Dual coding theory alleges the hypothesis that individuals code the information both in verbal and non-verbal ways. Schema theory suggests that there exist schemas or information networks within the memory and learners can relate new information to the existing knowledge organized in the schemas using graphic organizers. On the other hand, in cognitive load theory it is accepted that working memory (short-term memory) has a maximum capacity to process the information, therefore when the load is exceeded, learning does not take place. When they are used appropriately, graphic organizers reduce the cognitive load and enable reaching more resources so that the new material can be learnt (IARE, 2003, p. 5). Ellis (2004) similarly explains that graphic organizers reduce the requirement of meaningful information processing skills required to learn a material, make the information much more comprehensible making the information content organized and enable that the material can be handled at more complicated levels.

Graphic organizers, also named as visual maps, enable the use of skill areas of the brain entirely, help overcoming the information load and allow the information and resources to be collected in one place. Besides, they increase creativity providing flexibility in thinking and help the individuals perceive the information entirely. Moreover, they clarify the thoughts by means of relationships and organization, help the individuals solve problem, make decision and go into action and also they develop memory and comprehension (Krasnic, 2011).

Students who use graphic organizers can be more strategic learners. When the topic to be organized is clear, analytic skills besides reading and writing skills, communication skills, personal creative skills develop by means of graphic organizers (Ellis, 2004). Graphic organizers work as tools that also contribute to critical thinking because they help the individuals focus on what is really important by taking their attention to the key word, key concept and relationships between them (Bromley, Irwin-DeVitis, & Modlo, 1995). In National Reading Panel "NRP" report, it is expressed that graphic organizers are important research and comprehension strategy for both students and teachers. In this report, it is stated that these tools enable students use their skills to collect information in order, comprehend the relationship between information parts, organize and reflect the information and thoughts, synthesize the information, integrate thinking, reading and writing processes, use problem solving and higher level thinking skills in real life situations. Besides, it is suggested that graphic organizers give teachers chances to explain and exemplify abstract concepts and contribute to improvement of their students' research and comprehension of the interrelations skills, provide new vocabulary and concepts with second language learners using visual images, revise and evaluate the students' comprehension level as an after reading activity (National Institute of Child Health and Human Development [NICHD], 2000).

Types of Graphic Organizers

In the literature there are so many graphic organizers such as concept map, story map, semantic map, timetable, cause and effect map, fishbone diagram, flow chart, bubble map, story pyramid, Venn diagram, K-W-L schema, problem-solution diagram, mind map, listing, topic network, conceptual network, hierarchy, matrix, linear system, falling dominoes, diagnostic tree, knowledge map, knowledge network, T-chart, horizontal flow chart, framework and computer-based graphic organizers (Hughes, 2004; Newman, 2007; Olson, 2014; Scott, 2011). Concept map which is one of these graphic organizers is a technique that describes concepts by arranging them hierarchically from more general and larger concept to the more specific one (Novak & Gowin, 1984). Concept maps have some advantages such as organizing information about subject, motivating to study a subject, revising a subject, making a discussion about a subject, gradation of important ideas about a subject and consolidation of ideas about a subject (Malone & Dekkers, 1984). Mind map, on the other hand, is a visual learning-teaching material used with purpose of improving note-taking, enriching creativity, organizing thinking and developing a concept or an idea (Buzan & Buzan, 1996). Mind map is a technique in which ideas and relationships between ideas are visually represented in a non-linear way. Its main purpose is to establish creative relationships between ideas. In this sense, it is named as relationship map, too (Davies, 2010). These maps prompt individuals to be active, to focus and think, also they provide a specific link and structure in organization of the information in a sensible and meaningful way. Besides, they help the individuals customize the information as they understand and in accordance with their interests (Krasnic, 2011). Moreover, although semantic map is a type of a graphic organizer which visually shows hierarchic relationships between concept categories (Jonassen, Beissner, & Yacci, 1993), knowledge map is a similar tool that helps showing the relationships between knowledge records, dynamics, their importance and both explicit and implicit knowledge (Renukappa & Egbu, 2004 as cited in Eppler, 2008). On the other hand, K-W-L schema is a type of graphic organizer which attempts to answer the questions "What I Know?", "What do I Want to Learn?", "What I Learned?" and contributes to the improvement of the individual's meta-cognitional awareness (Stahl, 2003). Computer-based graphic organizers are digital diagram symbols that help organizing ideas visually (Boykin, 2015, p. 50).

Graphic organizers are accepted as important and effective educational tools because of organizing ideas&knowledge and facilitating comprehension of new information (McKnight, 2010, p. 1). Therefore, learners at all age levels benefit from graphic organizers and visual symbols in the practices related to a subject (Dye, 2000). As in other areas of the education in language learning and teaching area, graphic organizers are benefited and studies are conducted about the effect of these tools on the development of students' basic language skills. Studies reveal that graphic organizers contribute to improvement of thinking, comprehension and learning skills of students who study at different educational levels and have different skill (Boykin, 2015; DiCecco & Gleason, 2002; Ermis, 2008; Liu, Chen, & Chang, 2010; Newman, 2007; Pan, 2005; Ponce & Mayer, 2014; Vakilifard, 2008; Yaman, 2006). When the literature is reviewed, it is seen that the number of such studies are considerably high and in most of these studies, it is reported that graphic organizers have statistically significant effect on success but the degree of this significance is not defined. This situation makes the comparison of related similar studies' results and their interpretation more difficult. At this point, it is thought that meta-analysis which is a method to collect and synthesize the results obtained from individual studies can remove the restrictions.

Related Literature

When related literature is reviewed, it is seen that a meta-analysis study has been conducted which examines general effect of graphic organizers, specifically such graphic organizer types as concept map, mind map, etc. on students' academic success (Batdı, 2014, 2015; Dexter & Hughes, 2011; Erdoğan, 2016; Kang, 2002; Kim, Vaughn, Wanzek, & Wei, 2004; Moore & Readence, 1980, 1984; Nesbit & Adesope, 2006). Studies conducted by Moore and Readence (1980, 1984) include effect sizes of respectively 16 and 23 different studies which search for the effect of graphic organizers on students' comprehension level. However, the study conducted by Kang (2002) is limited to the students' ability

who have learning difficulty to comprehend what they read and includes related studies conducted between 1971-2000 years. Meta-analysis of Kim et al. (2004) include the studies conducted between 1963-2001. This study is limited to comprehending what they read and participators are similarly the students who have learning difficulties. In a research about concept and mind maps conducted by Nesbit and Adesope (2006), there exist eight studies about language learning and teaching but there is not any data about general effect sizes of these studies in the research because language learning/teaching or any other classification does not exist in their study areas. On the other hand, Dexter and Hughes (2011) conducted a meta-analysis study with a sample including students with learning difficulties, they included eight studies. Among them, four studies can be evaluated within area of English language art and other four studies can be evaluated within scope of language teaching/learning. Batdı (2014, 2015) conducted two studies related to concept maps and mind maps respectively. In the study related to concept maps, among studies included in meta-analysis, three studies can be evaluated in the scope of language learning/teaching. In the study related to mind maps, there is only one study.

When considered from this point, the motive for conducting this meta-analysis lies in the following reasons: some meta-analysis studies are not up-to-date in terms of time period because they belong to old periods, some of them are limited to a specific graphic organizer type, some include very few studies related to language learning/teaching area. Accordingly, this research aims to make an up-to-date and comprehensive meta-analysis by synthesizing primary studies which investigate the effect of graphic organizers on students' developmental levels and academic success in language learning areas and in this way it aims to determine general effect of graphic organizers on students' academic achievement. For this reason and scope, this research has preferred meta-analysis as research method. It is assumed that study results which are obtained from similar research design and independent variables contribute to interpretations being more powerful and coherent which are made considering relevant studies.

Method

Meta-analysis method is used in this study. Meta-analysis is a statistical process in which the results of various individual studies combined quantitatively in order to reach a general conclusion or summary among studies (Arthur, Bennett, & Huffcut, 2001). In the meta-analysis, the aim is to comprehend the results of a study as a part of all studies (Borenstein, Hedges, Higgins, & Rothstein, 2013, p. 9). Generally, there are three basic purposes of meta-analysis. The first one is to test whether the study results are homogenous or not, the second purpose is to find an index value in addition to statistical significance and confidence interval of effect size of the relationship which is examined and determine possible variables and characteristics that cause heterogeneity if there is a heterogeneity among (Huedo-Medina, Sánchez-Meca, Marín-Martínez, & Botella, 2006). In accordance with these purposes, practical steps and processes in performing this meta-analysis are given below:

Defining the Research Problem, Research Purpose and Dependent/Independent Variables

The first step of the meta-analysis is to define research purposes and problems as in other research attempts (Card, 2011, p. 16). The purpose of this research is determined as "to examine the effect of graphic organizers on basic language skills or the improvement of listening, reading, writing, grammar and vocabulary/phrase learning skills, which are classified as language learning areas in broader terms". Within this scope, experimental or quasi-experimental studies in which various tools regarded as graphic organizers are used as a special teaching technique in all education levels from preschool to undergraduate and which investigate whether or not the students' academic successes change significantly compared with traditional techniques are examined with a meta-analytic approach. In various studies, some study characteristics are determined as "what kind of graphic organizers are used as independent variables, graphic organizer type that is considered to affect students' academic improvement, language learning area, the type of publication reporting the research study, study area, education level at which the research is conducted, education level and experimental procedure. In this context, this research attempts to answer the following questions:

1) To what extent do graphic organizers affect students' academic success in language teaching and learning areas?

2) Is there a significant difference among the effect sizes of the studies according to the type of graphic organizers used in experimental procedure?

3) Is there a significant difference among the effect sizes of the studies according to language learning areas (listening, reading, writing, grammar and general comprehension and speaking skills) in which experimental procedure take place?

4) Is there a significant difference among the effect sizes of the studies according to the type of publication (thesis, article) in which the research is reported?

5) Is there a significant difference among the effect sizes of the studies according to study areas (Teaching English as a Native Language [TENL], Teaching English as a Second Language [TESL], Teaching English as a Foreign Language (TEFL) and Teaching Turkish as a Native Language [TTNL]) in which the experimental procedure takes place?

6) Is there a significant difference among the effect sizes of the studies according to educational levels at which the experimental procedure takes place?

7) Is there a significant difference among the effect sizes of the studies according to the time of the experimental procedure?

Literature Review

The next step after determining the research problem is literature review. For this purpose, following sources are benefitted: online libraries of Hacettepe University, Sakarya University and Çanakkale Onsekiz Mart University; thesis and data banks of the Council of Higher Education International Thesis Center and 'Proquest Dissertations and Thesis Global', Educational Resources Information Center (ERIC), EBSCOHOST, Cambridge Journals Online, ScienceDirect, Scopus and SpringerLink and Ulakbim Social Sciences Data-Base and Academic Council of Higher Education Data Base. Literature review is conducted by using the key words "graphic organizer", "graphic editor", "concept map", "mind map", "K-W-L", "semantic map", "knowledge map" (both in Turkish and English).

Determining of "Inclusion Criteria"

The quality of a meta-analysis study depends on the quality of studies included in the meta-analysis. Therefore, it is a critical step to formulate the criteria which will be considered while choosing the studies to be included in meta-analysis. If the inclusion criteria are too broad, the quality of the studies can weaken, ultimately this may reduce the reliability. If the criteria are too strict, results are taken from a few studies and they cannot be generalized (Lam & Kennedy, 2005, p. 171). In this study, in order not to experience both negative situations above, those criteria have been taken into consideration while determining the studies to be included in the meta-analysis:

1) Studies should be conducted in the language learning/teaching area,

2) Studies should be master's/doctoral thesis or academic articles published in print/electronic journals,

3) There should be at least one experimental group in the study and graphic organizers should be used while teaching the participants in the experimental group,

4) There should be at least one control group and traditional methods should be used in teaching of the participants in the control group,

5) Studies should be published between 2000-2016 years,

6) Success levels in comprehending what you read and listen, writing, learning grammar, learning vocabulary/phrase or sub-dimensions of these success levels should be determined as dependent variable in the study,

7) Studies should include quantitative data such as sample sizes, standard deviation and arithmetic means which are required to measure effect size of the studies.

As a result of analysis which aims to identify which studies meet the inclusion criteria; 242 studies are excluded: 76 studies which are not about language teaching and learning area (Science, Mathmetics, Marketing, Statistics, Information technologies etc.); 83 studies which are conducted with reserch methods not suitable for meta-analysis (quantitative studies, single subject/group studies without control group etc.); 47 studies which fail to include sufficient experimental data for effect size calculation; and 36 studies which make use of different variables as dependent variable instead of academic success (attitude, self-efficacy, motivation etc).

Coding Process and Ensuring its Validity & Reliability

Seventy studies have been included in meta-analysis which meet the inclusion criteria out of the studies compiled at the end of literature review. These studies have been coded with the help of a form developed by the researcher. Coding form is composed of two parts. In the first part, there exists information related to area of language learning, the name of the study, writer/writers of the study, publishing year, publication type, place where the study has been conducted, educational level at which study has been conducted, duration of application, what kinds of graphic organizers are used in the study and area of study. Second part includes sample sizes of control group and experimental group, standard deviation and arithmetic mean values which are all required for effect size calculation.

Expert opinion has been consulted for content validity of coding form. For this purpose, two experts which work as academic staff in Departments of Turkish Teaching and Educational Science have been informed about the aim of study, its scope and process. In direction with experts' opinion and suggestion, one more question has been added to coding form asking for which language learning area study has been conducted in. Also, coding form has been transformed into electronic form and coding has been done in digital environment. Two important qualities of coding process are "making a detailed section for method which allows critical evaluation of what processes are used as a part of study (transparency) and performing an identical or equal study in order to establish accuracy of original findings (reproducibility). For ensuring transparency and reproducibility, it must be properly defined how each study characteristics have been assessed (Wilson, 2009, pp. 160-161). At this point, it is aimed to be a transparent and reproducible study through processes intended for coding reliability.

Coding reliability is the most important factor which determines the quality of research synthesis. Both internal and inter-rater reliability are crucial. Internal reliability means coding of one single coder shows consistency from one setting to another setting or from time to another time. In a research synthesis, because a large number of studies are coded, items can be interpreted differently and this may result in coding inconsistency. Accordingly, items with low reliability should be recoded for ensuring accuracy (Wilson, 2009, p. 174). Additionally, inter-rater reliability is coherency between different coders. Therefore, a study sample should be evaluated by at least two people. In meta-analysis with small size, generally binary coding is done; in meta-analysis with larger synthesis, a study sample which are chosen randomly are coded (Wilson, 2009, pp. 174-175). For intracoding reliability, coding process of meta-analysis has been spread over a longer time, some studies which put a strain in coding process have been recoded later. Additionally, 14 studies which are chosen randomly have been coded by a second coder for inter-rater reliability. Then, Cohen's kappa (Cohen's κ) measurement has been preferred for evaluation of agreement between two independent coders. Kappa index presents invaluable information about identification of reliability and other examination processes when it is used and interpreted appropriately. Kappa index presents real agreement ratio by correcting the part of agreement which emerges by chance (Sim & Wright, 2005). In calculation, Cohen's Kappa index has been specified as κ=0,86. This measurement is between range of .81-1 in classification of Landis and

Koch (1977) which means "almost perfect fit" (as cited in Sim & Wright, 2005). Table 1 shows the descriptive data about the studies included in the meta-analysis.

Table 1. Descriptive Data Regarding the Studies Included in the Meta-Analysis

Study Characteristics ***(Variables)***		**Frequency (*f*)**	**Percentage (%)**
Publication Year	2000-2005	10	14,3
	2006-2010	15	21,4
	2011 +	45	64,3
Publication Type	Thesis	27	38,5
	Article	43	61,4
Region	Domestic (Turkey)	18	25,7
	Abroad	52	74,3
Region in Turkey	Eastern Anatolia	8	44,4
	Aegean	4	22,2
	Central Anatolia	3	16,7
	Marmara	2	11,1
	Mediterranean	1	5,5
Educational Level	Primary School	8	11,4
	Secondary School	19	27,1
	High School	9	12,9
	Undergraduate	32	45,7
	Adult Education	2	2,9
Duration of Experimental Procedure	1-3 weeks	10	14,3
	4-6 weeks	16	22,9
	7-9 weeks	7	10,0
	10-12 weeks	10	14,3
	13 weeks and more	6	8,6
	Not reported	21	30,0
Graphic Organizer Type	Semantic Map	3	4,3
	Knowledge Map	2	2,9
	CBGO	6	8,6
	GO	18	25,7
	Concept Map	30	42,9
	K-W-L	2	2,9
	Mind Map	9	12,9
Study Areas	ELT	14	20,0
	TESL	6	8,6
	TEFL	38	54,3
	TLT	12	17,1
Language Learning Area	Grammar	4	5,7
	Listening	4	5,7
	General	8	11,4
	Vocabulary Teaching	5	7,14
	Reading	31	44,3
	Writing	18	25,7

CBGO = Computer based graphic organizer; GO = More than one graphic organizer; K-W-L = What I Know? What do I Want to Learn? What I Learned?; General = General Comprehension and Expression Skills.

When Table 1 is reviewed, it is observed that there is an increase in number of quasi experimental/experimental studies which analyze the effect of graphic organizers on success in language teaching and learning areas. 14,3 percent of studies (*f*=10) were conducted between 2000-2005; 21,4 percent of studies (*f*=15) between 2006-2010; 64,3 percent of studies (*f*=45) 2011 and later. Among studies included, 38,5 percent (*f*=27) are published as thesis; 61,4 percent (*f*=43) are published as articles. Also, Bunun yanında meta analiz kapsamında incelenen çalışmaların 74,3 percent of studies (*f*=52) were conducted in foreign countries, not in Turkey. These foreign countries include the United States of America, Iran, Taiwan, Iraq, Saudi Arabia, China, Indonesia, India, Japan, Canada and France. The studies which were conducted in Turkey correspond only to 25,7 percent of all studies (*f*=18). Among those studies which were conducted in Turkey; 44,4 percent (*f*=8) were done in Eastern Anatolia Region, 22,2 percent in (*f*=4) Egean, 16,7 percent in Central Anatolia Region, 11,1 percent (*f*=2) in Marmara Region and 5,5 percent (*f*=1) in Mediterranean Region.

As a result of analysis, it's been observed that 45,7 percent of studies (*f*=32) were conducted with undergraduates, and then respectively 27, 1 percent (*f*=19) with secondary school students; 12, 9 percent (*f*=9) with high school students; 11,4 percent (*f*=8) with primary school students. The lowest number of studies (%2,9 (*f*=2)) were done with adults. Analyzing the duration of implementation, it's been observed that 30 percent of studies did not report the duration of implementation. Additionally, it's found out that 22,9 percent of studies (*f*=16) lasted 4-6 weeks; 14, 3 percent of studies (*f*=10) lasted 1-3 weeks; 14,3 percent (*f*=10) 10-12 weeks; 10 percent (*f*=7) 7-9 weeks; 8,6 percent (*f*=6) lasted 13 or more weeks.

The most common graphic organizer type in experimental procedures have been concept maps with 42,9 percent (*f*=30). In addition, more than one graphic organizer type is used in 25,7 percent of studies (*f*=18); mind maps are used in 12,9 percent of studies (*f*=9); computer based graphic organizers are used in 8,6 percent of studies (*f*=6); semantic maps are used 4,3 percent of studies (*f*=3); knowledge maps are used in 2,9 percent of studies (*f*=2); and K-W-L flow diagrams are used in 2,9 percent of studies (*f*=2). It's also seen that 54,3 percent of studies -which were included into meta-analysis - (*f*=38) are about "Teaching English As a Foreign Language", 20 percent of studies (*f*=14) about "Teaching English As a Native Language", 17,1 percent of studies (*f*=12) about "Teaching Turkish As a Native Language", and 8,6 percent of studies (*f*=6) about "Teaching English As a Second Language".

When we look at distribution of language learning areas, it' is observed that 44,3 percent of studies (*f*=31) were done in reading area; 25,7 percent of studies (*f*=18) were done in writing area; 11,4 percent of studies (*f*=8) in general area; 7,14 percent of studies (*f*=5) were done in vocabulary teaching area. The smallest number of studies (5,7 percent (*f*=4)) were done in grammar and listening areas.

Effect Size Measures and Data Analysis Plan

Effect size is a basic unit of a meta-analysis and it reflects the strength of the relationship between two variables or the size of practical effect (Borenstein et al., 2013, p. 3). In the analysis of the data, treatment effect meta-analysis technique has been used. In the treatment effect meta-analysis, inclusion criteria are determined very selectively. The studies which have serious procedural defects are excluded from the meta-analysis. The effect size has been measured for each study so that equal weights of the studies included in the analysis are given while the data independence is protected (Bangert-Drowns & Rudner, 1991). 37 studies (52,9%) of the studies included in the meta-analysis present data about the mean value and the standard deviation value, (30%) 21 studies present data about sample sizes and *p or F* values and 6 studies (8,6%) present data about mean value and *t* value. On the other hand, Cohen's *d* or Hedge's *g* values are reported in 6 studies (8,6%). Hedge's *g* effect size index which reveals the difference between winsorized mean and standardized mean among groups has been preferred in the effect size measures of the studies (Borenstein et al., 2013). The tendency to show the certain value in the small samples overmuch may cause small bias of *d.* In this stage, for an unbiased estimate of Cohen's *d,* Hedge's g index should be preferred (Borenstein et al., 2013 as cited in Hedges, p. 27). Cohen's *d* and Hedge's g index have been used in calculating effect sizes in this study.

Effect size values have been interpreted according to the standards defined by Cohen (1988, p. 82). Accordingly, if the effect size is 0,20 or below it, it is interpreted as "small effect size"; if it is between 0,20-0,80, it is "medium effect size" and if it is 0,80 or higher, it is "large effect size". Comprehensive Meta-Analysis "CMA" statistics program (Borenstein et al., 2005) has been used for calculating the effect sizes. As specified by Cooper and Hedges (1994), with the purpose of preventing dependency in the effect size data, an average effect size has been calculated for studies which have more than one effect size value and only one effect size value has been recorded for each study in the analysis. Moreover, the studies which are published as both thesis and article and which report the same results have been regarded as one study and only one effect size value has been recorded in the analysis. Also, in order to identify publication bias, Funnel plot, Rosenthal's Fail-safe N test and Orwin's Fail-safe N formula for calculating the necessary number of studies in order to remove significance of effect size values have been used.

Research Validity and Publication Bias

The biggest problem in meta-analysis is remarked as publication bias (Copas & Shi, 2000) and this situation is the greatest threat to the validity of meta-analysis (Sutton, 2009). Publication bias depends on assumption that the studies whose results are statistically significant are probably published more than those which are not (Greenhouse & Iyengar, 2009, p. 428). Funnel plot, Rosenthal's Fail-safe N test and Orwin's Fail-safe N formula has been used in order to determine publication bias and how good meta-analysis is.

Funnel plot is regarded as the best exploratory tool for investigating publication bias and presents a visual summary of meta-analytic data set which looks like forest plot (Sterne, Becker, & Egger, 2005). Funnel plot is a visual diagnostic which helps evaluating file drawer problem informally (Greenhouse & Iyengar, 2009, p. 429). This graphic is basically a scatter plot which compares measurement of effect sizes and study size precision (Sutton, 2009). Figure 1 shows the graphic figure of Funnel plot which is the first test done for determining study bias:

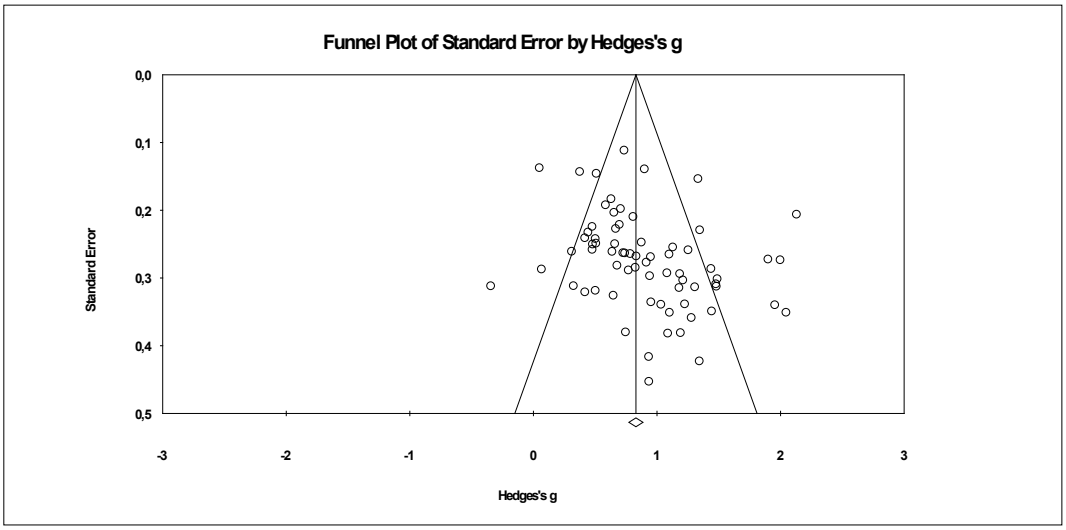

Figure 1. Funnel Plot Related to Study Bias

When graphic is reviewed, it is clear that effect sizes show symmetrical distribution. This situation shows that there is no publication bias and analysis is good. Also, a large number of studies included in study sample is viewed as a factor which increases the reliability of analysis. Rosenthal's Fail-safe N test which is another test for determining study bias supports the data in Funnel plot:

Table 2. Rosenthal's Fail-Safe N Test Data which Shows Publication Bias Situation in Publications which Form the Study Sample of Meta-Analysis

Z-value for reviewed studies	28,70442
p-value for reviewed studies	0,00000*
Alpha	0,05000
Direction	2
Z-value for Alpha	1,95996
The number of studies reviewed	70
Fail-safe Number [FSN]	4945

*$p<.05$

When Table 2 is reviewed, in order for p=0,00 statistically significance value to be p>0,05; in other words, 4945 studies with "zero" effect size value should be conducted in order to remove significance of meta-analysis result.

If Rosenthal FSN value is bigger compared to the number of reviewed studies, it is assumed that results are resistant to publication bias (Rosenthal as cited in Üstün & Eryılmaz, 2014). If the value which is obtained by *N/(5k+10)* formula developed on basis of this suggestion is bigger than 1, it is concluded that meta-analysis is adequately resistant to studies in future (Mullen, Muellerleile, & Bryant as cited in Üstün & Eryılmaz, 2014). In this meta-analysis study which investigates the effect of graphic organizers on development of language skills area and academic achievement, the value which is obtained by using this formula is determined as "13,73". As this value is quite bigger than 1, it is concluded that results of this meta-analysis are resistant to primary studies which will be conducted in similar topics.

Thirdly, Orwin's Fail-safe test has been used for determining publication bias and its findings overlap with Rosenthal's Fail-safe N test. These findings are presented in Table 3:

Table 3. Orwin's Fail-Safe N Test Data which Shows Publication Bias Situation in Publications which Form the Study Sample of Meta-Analysis

Hedge *g in reviewed studies*	0,82966
Criteria for a "nonsignificant" Hedge g	0, 10000
Hedge *g* mean for missing studies	0, 00000
The number of necessary missing studies in order to reduce Hedge *g* value to below 0,1 (FSN)	511

As seen in Table 3, for lowering Hedge *g* value to 0,1 and evaluating general effect size values as "nonsignificant", there should be conducted 511 studies with "zero" effect size values. Also, 221 studies should be conducted in order to reduce Hedge *g* value to 0,2 and 47 studies with zero effect size should be conducted for 0,5 value.

Heterogeneity Test and Meta-Analysis Model

In a meta-analysis, first stage is generally to predict average effect size and its variance and then assess the magnitude of heterogeneity between studies (Pigott, 2012, p. 16). Assessing heterogeneity is crucial in meta-analysis because existence or non-existence of true heterogeneity (heterogeneity between studies) affect the decision of which statistical model will be applied to meta-analytic database (Huedo-Medina et al., 2006). In this study, heterogeneity analysis has been done for determining which meta-analysis model will be used in interpretation of obtained effect size values. Table 4 shows data related to homogeneity/heterogeneity analysis under fixed effects model:

Table 4. Findings Related to Effect Sizes of Studies According to Fixed Effects Model

Average Effect Size (*g*)	Degree of Freedom (*df*)	Homogeneity Value (*Q*)	Chi-Square Table Value (χ^2)	Standard Error (*SE*)	I^2	%95 Confidence Interval for Effect Size (ES, %95CI)	
						Lower Limit (Min.)	Upper Limit (Max)
0, 830	69	253,337	89,391	0,029	72,764	0,733	0,887

I^2 = The ratio of true heterogeneity to total change in observed effect.

When analysis results in Table 4 are reviewed, *Q* statistical value is calculated as 253,337. This value is pretty higher than critical value of 89,391 which is estimated for 69 degree of freedom (for %95 confidence interval). On the other hand, if meta-analysis includes a few studies, *Q* statistical fail to determine true heterogeneity between studies and it only gives information about statistical significance. *As* I^2 can be interpreted as the ratio of true heterogeneity to total variance in a sequence of effect size thanks to true heterogeneity of within-study variance, it can assess heterogeneity with greater accuracy (Huedo-Medina et al., 2006). Therefore, I^2 value has also been interpreted in order to determine the existence or non-existence of true heterogeneity between studies. When we look at table, it is seen that I^2 value is %72,764. This means that true heterogeneity or percentage of total variance which can be attributed to variance between studies appear as 72,76. In other words, 72,76 percent of variance is inter-studies variance, 27,2 percent is within-study variance based on random error. In I^2 *value classification of* Higgins and Thompson (2002), %25 (I^2=25) low, %50 (I^2=50) medium and %75 (I^2=75) is interpreted as high level of heterogeneity. According to this classification, the obtained value of %72,764 (I^2=72,764) is close to high level of heterogeneity value. Also, *p* value is smaller than significance value *p*=.05 with the value .000. All these values (*Q*=253,337, *p*<.05, I^2=72,764) show that there is a heterogeneous distribution between effect sizes and random effects model should be used for interpretation of effect sizes.

Results

After determining that the studies are heterogeneous, effect sizes have been integrated with the random effects model. After integration, the findings have discussed and interpreted according to research questions.

1. In which level do the graphic organizers have effect on academic success of the students compared with traditional techniques?

Appendix 1 shows the distribution of upper and lower limit values for effect sizes in 95% confidence interval according to random effect size model for the difference between winsorized mean and standardized mean, Hedge's g effect size index, standard error, variance and *p* values belonging to the experimental studies which examines the effect of graphic organizers on students' academic success in the basic language skills areas. The findings related to the effect sizes of the studies according to random effects model are given in Table 5:

Table 5. Findings Related to the Effect Sizes of the Studies according to Random Effects Model

Average Effect Size (*g*)	*N*	Standard Error (*SE*)	Variance (*v*)	*Z*	*p*	95% Confidence Interval for Effect Size (ES, %95CI)	
						Lower Limit (Min)	Upper Limit (Max)
0, 897	70	0,058	0,003	15,485	0,000*	0,784	1,011

**p<.05*

As seen in the Table 5, general effect size values related to the effect of graphic organizers on the improvement at language skill areas and academic success have been determined as Hedge's g=0,897 with 0,058 error according to the random effects model. This value is a high level effect according to Cohen (1988) classification. Again, according to random effects model, lower limit of effect size has been determined as 0,784 at 95% confidence interval while the upper limit has been calculated as 1,011. Values related to the effect sizes are statistically significant (Z=15,485; p=.00). These findings reveal that graphic organizers are extensively effective on students' academic success levels at the basic language skills areas.

2. Is there a significant difference between effect sizes of the studies according to the type of the graphic organizer used in experimental procedure?

Table 6 presents the findings about whether or not the effect sizes of the studies significantly differentiate according to graphic organizer types such as semantic map, knowledge map, computer-based graphic organizer, more than one graphic organizers, concept map, K-W-L and mind map:

Table 6. Findings Related to the Effect Size according to the Graphic Organizer Type and Heterogeneity Test

Model		**95% Confidence Interval (95%CI)**		**Degreeof Freedom (*df*)**	**Heterogeneity Test**	
Random Effects Model	Hedge *g*	Lower Limit	Upper Limit		*Q* Value	*p* Value
Semantic Map	0,889	0,242	1,536	6	9,381	0,152
Knowledge Map	0,569	0,202	0,937			
CBGO	0,653	0,478	0,829			
GO	0,991	0,738	1,243			
Concept Map	0,967	0,771	1,163			
K-W-L	0,707	0,127	1,287			
Mind Map	0,838	0,564	1,111			

CBGO = Computer based graphic organizer; GO = More than one graphic organizer; K-W-L = What I **K**now? What do I **W**ant to Learn? What I **L**earned?

When Table 6 is examined, it is seen that all effect sizes are positive and effect size value of the studies abbreviated as GO in which more than one graphic organizer types are used is g= 0,991 that is, higher than other types. Concept map (g=0,967), semantic map (g=0,889) and mind map (g=0,838) follow GO respectively. Graphic organizer types which have lower effect sizes are K-W-L flow chart (g=0,707), computer-based graphic organizers (g=0,653) and knowledge map (g=0,569). While K-W-L chart, CBGO and knowledge map have a general effect at medium level, GO, concept map, semantic map and mind map have a larger effect. On the other hand, this research examined whether or not the effect sizes obtained from individual studies significantly differentiate according to graphic organizer type and it is found out that Q_B=9,381 value in the $\chi 2$ table is at 95% significance level, under the critical value 12,592 determined by the degree of freedom 6. Q value among groups under the critical value shows that students' academic success does not significantly differentiate according to the type of the graphic organizer.

3. Is there a significant difference between effect sizes of the studies according to language learning areas (listening, reading, writing, grammar and general comprehension and expression skills) in which experimental procedure takes place?

Table 7 presents the findings about whether there is a significant difference between effect sizes of the studies according to language learning areas (listening, reading, writing, grammar and general comprehension and expression skills):

Table 7. Findings Related to the Effect Sizes according to Language Learning Area in which Graphic Organizers are Used and Heterogeneity Test

Model		**95% Confidence Interval (95%CI)**		**Degreeof Freedom (*df*)**	**Heterogeneity Test**	
Random Effects Model	Hedge *g*	Lower Limit	Upper Limit		*Q* Value	*p* Value
Grammar	0,675	0,392	0,958			
Listening	1,394	0,639	2,149			
General	1,138	0,727	1,548	5		
Vocabulary Teaching	0,731	0,380	1,083		6,077	0,299
Reading	0,815	0,655	0,974			
Writing	0,877	0,725	1,029			

General = General Comprehension and Expression Skills.

When Table 7 is examined, it is seen that all effect sizes have positive values and effect size of listening skills area is *g*=1,394 that is higher than others. Other skill areas following listening are listed as general (*g*=1,138), writing (*g*=0,877), reading (*g*=0,815), vocabulary teaching (*g*=0,731) and grammar (*g*=0,675) from highest to lowest according to their effect size. Graphic organizers have medium effect sizes at grammar and vocabulary teaching skills area; they have big effect sizes at writing, reading, listening and general skills areas. This research examined whether effect sizes significantly differentiate according to language learning areas, it is found out that Q_B=6,077 value in the $\chi 2$ table is at 95% significance level under the critical value 11,071 determined by the degree of freedom 5. Q value under critical value reveals that students' academic success does not significantly vary according to language learning areas in which graphic organizers are used.

4. Is there a significant difference between effect sizes of the studies according to the type of the publication (thesis, article) in which study is reported?

Table 8 presents the findings about whether effect sizes of the studies differentiate according to the type of publication (a thesis or an article):

Table 8. Findings about Effect Sizes according to Publication Type and Heterogeneity Test

Model		**95% Confidence Interval (95%CI)**		**Degreeof Freedom (*df*)**	**Heterogeneity Test**	
Random Effects Model	Hedge *g*	Lower Limit	Upper Limit		*Q* Value	*p* Value
Artice	0,937	0,800	1,075	1	0,722	0,395
Thesis	0,833	0,635	1,031			

When Table 8 is examined, it is seen that both effect sizes have positive values and effect size of the studies published as an article is calculated as *g*=0,937 while effect size of the studies published as thesis is calculated as *g*=0,833. Graphic organizers have large effect on the studies published both as thesis studies and articles. This research examined whether effect sizes significantly differentiate according to type of publication and it is found out that Q_B=0,722 value is under the critical value 3,8415 determined by 5 degree of freedom for 95% confidence interval. These findings reveal that the students' academic success does not differentiate according to type of publication (thesis or article) in which the study is reported.

5. Is there a significant difference between effect sizes of the studies according to the study areas in which the experimental procedure takes place (English Language Teaching [ELT], Teaching English as a Second Language [TESL], Teaching English as a Foreign Language [TEFL] and Turkish Language Teaching [TLT])?

Table 9 presents findings about whether effect sizes of the studies significantly differentiate according to study areas in which experimental procedure takes place:

Table 9. Effect Sizes according to Study Areas and Heterogeneity Test

Model		**95% Confidence Interval (95%CI)**		**Degreeof Freedom (*df*)**	**Heterogeneity Test**	
Random Effects Model	Hedge *g*	Lower Limit	Upper Limit		*Q* Value	*p* Value
ELT	0,867	0,579	1,154	3	0,105	0,991
TESL	0,930	0,455	1,406			
TEFL	0,899	0,749	1,049			
TLT	0,924	0,678	1,171			

As seen in the Table 9, all effect sizes have positive values and effect size values are quite close to each other. Graphic organizers have large effect sizes at all four areas respectively *g*=0,930; *g*=0,924; *g*=0,899 and *g*=0,867 (ESL, ESL, EFL and TLT). When it is examined whether effect sizes significantly differentiate according to study areas, it is seen that Q_B=0,105 value is under the critical value 7,815 determined by 3 degree of freedom for 95% confidence interval. Q value under the critical value among groups reveals that the students' academic success does not significantly differentiate according to study area in which graphic organizers are used.

5. Is there a significant difference between effect sizes of the studies according to educational level at which experimental procedure takes place?

Table 10 presents the findings about whether effect sizes of the studies differentiate according to educational level:

Table 10. Findings Related to Effect Sizes according to Educational Level at which the Study Has Been Conducted and Heterogeneity Test

Model		**95% Confidence Interval (95%CI)**		**Degreeof Freedom (*df*)**	**Heterogeneity Test**	
Random Effects Model	Hedge *g*	Lower Limit	Upper Limit		*Q* Value	*p* Value
Primary School	1,183	0,690	1,676	4	1,863	0,761
Secondary School	0,856	0,710	1,003			
High School	0,905	0,490	1,319			
Undergraduate	0,857	0,702	1,012			
Adult Education	1,019	0,437	1,601			

When Table 10 is examined, it is seen that all effect sizes have positive values and they are at large level. Moreover, graphic organizers' effect size at primary school level (*g*=1,183) is higher than effect sizes at other educational levels. The effect sizes belong to other educational levels are respectively adult education (*g*=1,019), high school education (*g*=0,905), undergraduate education (*g*=0,857) and secondary school education (*g*=0,856) from highest to lowest. This difference between effect sizes is not statistically meaningful because it is under 9,488 critical value determined by 4 degree of freedom at 95% significance level in $\chi 2$ table of Q_B=1,863 value. In other words, students' academic success does not significantly differentiate according to educational levels at which the graphic organizers are used.

6. Is there a significant difference between effect sizes according to the duration of the experimental procedure?

Table 11 presents the findings about whether effect sizes of the studies vary according to how long implementation takes place:

Table 11. The Findings about Effect Sizes according to Duration of the Expreimental Procedure and Heterogeneity Test

Model		**95% Confidence Interval (95%$_{CI}$)**		**Degreeof Freedom (*df*)**	**Heterogeneity Test**	
Random Effects Model	Hedge *g*	Lower Limit	Upper Limit		*Q* Value	*p* Value
1-3 weeks	0,916	0,714	1,119	5	10,796	0,056
4-6 weeks	1,007	0,702	1,312			
7-9 weeks	0,539	0,265	0,736			
10-12 weeks	0,500	0,574	1,216			
13 weeks and more	0,860	0,619	1,101			

When Table 11 is examined, it is seen that all effect sizes have positive values. However, the difference between effect sizes is not statistically meaningful because it is under critical value 11,071 determined by 5 degree of freedom at 95% significance level in $\chi 2$ table of Q_B=10,796 value. There is no significant difference in students' academic success according to the duration of the experiment in which graphic organizers are used.

Discussion and Conclusion

Within the scope of this study which aims to investigate whether graphic organizers have significant effect on student achievement related to area of language skills compared with traditional techniques, 70 studies have been analyzed by using meta-analysis method. At the end of study, it is found out that only 1 study has negative effect size, and 69 studies have positive effect sizes. Research results show that graphic organizers have high level effect size on academic achievement compared to traditional teaching methods (Hedge *g*=0,897, %95$_{CI}$=0,784-1,011). Comparing the obtained general effect size value to the similar studies, following results show up:

Two meta-analysis have been conducted by Moore and Readence (1980, 1984) in order to determine graphic organizers' effect on the comprehension of informative texts. In the first meta-analysis, 16 studies have been included and at the end it appears that graphic organizers have a small effect size (*d*=0,15) on learning outcomes. In the second meta-analysis, 23 studies have been analyzed with the same method and again, a small effect size (*d*=0,22) has been obtained. These studies reveal that graphic organizers have a limited effect on comprehension. Moreover, Kim et al. (2004) investigated graphic organizers' effect on reading comprehension level of the students who had learning difficulty. Their study in which effect sizes of 21 studies between 1963-2001 were calculated revealed that generally semantic organizers, cognitive maps with/out reminders improved reading comprehension levels of the students at different levels. Kang (2002) similarly examined 40 studies with meta-analysis method, conducted between 1971-2000 and in which graphic organizers were used as independent variables in improving reading comprehension and recognition levels of the students who had learning difficulty. In this study, it has been concluded that graphic organizers have a large effect size changing between *d*=0,76 and *d*=1,39 on learning and comprehension. Using meta-analysis method, Dexter and Hughes (2011) examined 16 studies which included practices in Reading, Sciences, Social Sciences and Mathematics areas in which cognitive maps, semantic maps and visual demonstrations were used. As a result of the research, when the last tests are analyzed, it is inferred that graphic organizers have a

large effect size at d=0,91 level on comprehension skills. Using meta-analysis method, Batdı (2014) examined 40 studies conducted between 2008-2013 which analyzed the effects of concept maps on academic success and permanence. As a result of the research, it has been concluded that concept maps have large effect sizes d=1,0696 on academic success and d=1,132 on permanence. In another research, Batdı (2015) examined 15 scientific studies by using meta-analysis method, conducted between 2005-2013 which investigated the effect of mind mapping technique on the students' academic success and permanence of their knowledge. As a result, he concluded that mind mapping technique has an effect d=1,057 on academic success and d=0,431 on permanence. In conclusion, it is revealed that mind mapping has a positive effect on academic success and permanence. Similarly, using meta-analysis method, Erdoğan (2016) examined 73 studies conducted between 200-2015 which investigated the effect of concept map teaching strategy. As a result of the research, it is concluded that concept mapping strategy has a positive effect on Turkish students' academic success. In the research, it is inferred that concept mapping method has a large effect size g=1,119 on student success. On the other hand, Nesbit and Adesope (2006) examined 55 studies which were conducted by using concept map and knowledge map. Effect sizes of six studies selected from these studies have been reported in terms of attitude, self-sufficiency, motivation and learning strategies. Besides, it has been investigated about whether effect sizes of 18 studies significantly differentiate according to the study characteristics such as education level, learning environment, study area and duration of study. Also, this study included weighted averages of effect sizes according to individual differences such as abilities in learning areas and verbal skill levels. As a result of the meta-analysis, it has been concluded that concept map activities are more effective on knowledge acquisition, information storage and information transfer when they are compared to such activities as passage reading, participation in lessons and discussions. Concept map technique is defined to be slightly more effective than other structuralist activities such as writing summary and outlining. According to the results of the study, concept maps are significantly effective when they are provided to the students who have low verbal knowledge and abilities. As a conclusion, it is possible to assert that the results related to the general effect sizes of this meta-analysis studies correspond with the results obtained from this study.

In this study which aims to investigate the effect of graphic organizers on academic achievement, intervening variable analysis has been done in order to determine whether effect size values differ significantly according to study characteristics which include graphic organizer type, language learning area, type of publication in which application is reported, study area, educational level at which application occurred and duration of application. At the end of analysis, findings related to each study characteristic are given in the following paragraph:

Graphic organizer types: Effect sizes obtained from studies do not differ significantly according to graphic organizer types (Q_B=9,381<$\chi 2$=12,592). Dexter and Hughes (2011) in their meta-analysis study reveal that there is no significant difference between different graphic organizers in terms of comprehension. However, mental maps and mental map derivatives make significantly more contribution to achievement than other graphic organizers in terms of continuity of knowledge. Therefore, result of this study shows similarity with study of Dexter and Hughes (2011) to a certain extent.

Language learning areas: Effect sizes obtained from studies do not differ significantly according to language learning areas in which graphic organizers are used (Q_B=6,077<$\chi 2$=11,071). Among various meta-analysis studies, in terms of language learning areas, Kang (2002) conducted a study in which he made significance level comparisons among effect sizes depending partially on such a classification. Kang (2002) concludes that reading comprehension and word acquisition effect size values are statistically significantly higher than content learning area (phenomenon and relational information) ($d_{reading}$=0,89, d_{word} =0,80>$d_{content}$=0,54). In other words, graphic organizers make contribution to achievement in reading comprehension and word acquisition areas at high level.

Publication type: Effect sizes obtained from studies do not differ significantly according to type of publication (article or thesis) in which study has been reported (Q_B=0,722<$\chi 2$=3,8415). Likewise, there is found no research specifically related to graphic organizers which investigates the differentiation situation according to type of publication.

Study areas: Effect sizes obtained from studies do not differ significantly according to study areas in which graphic organizers are used (Q_B=0,105<$\chi 2$=7,815). In literature, there are effect size comparisons among various study areas. Dexter and Hudges (2011) infer that graphic organizer usage contributes to comprehension skills in Reading, Sciences and Social Sciences areas more than in Mathematics area in terms of permanence of knowledge, however graphic organizer usage in Science area is significantly more effective on students' success. Besides, general effect size of the studies conducted in English Language Arts area has been calculated as g=0,9612. Kang (2002) explained in his study that there is not a significant difference in effect sizes between Sciences and Social Sciences/History areas. Batdı (2014) reached a similar result in his research about concept maps. In his research, general effect size of the studies conducted in Foreign Language area is calculated as d=2,19 while the effect size of the studies in Social Sciences area including Turkish is calculated as d=1,386. Therefore, it is concluded that concept maps have large effect sizes on both areas.

Educational level: Effect sizes obtained from the studies do not differ significantly according to educational level at which graphic organizers are used (Q_B=1,863<$\chi 2$=9,488). While the results of this research contrast with the results of the study conducted by Kang (2002) and Batdı (2014), they correspond with the results of the study conducted by Kim et al. (2004). Kang (2002) reported that effect sizes of graphic organizers on students' success significantly differ at three educational levels (upper levels of primary school, secondary school and high school); and the highest effect size value is (d=1,04) at high school and the lowest effect size is (d=0,47) at secondary school level. Similarly, Batdı (2014) determined that effect sizes of concept map, one of the graphic organizer types, on students' success have significant difference according to educational levels; more clearly the highest effect size is calculated as (d=1,550) at high school level and the lowest effect size is calculated as (d=0,629) at university level. On the other hand, Kim et al. (2004) reported that graphic organizers have a large effect size on reading comprehension success at primary school, secondary school and high school levels but the difference between effect sizes is not statistically significant.

Duration: It is concluded that effect sizes obtained from studies do not differ significantly according to the duration of the studies in which graphic organizers are used (Q_B=10,796<$\chi 2$= 11,071). Results of this study correspond with the results of the studies conducted by Kang (2002) and Batdı (2014). Both researchers have pointed out in their studies that duration of using graphic organizers does not have a significant effect on academic success.

Improving language learning skills is a social requirement, not a purpose just limited with learning goal of teaching a native language, a second language or a foreign language. Thus, an individual's competences of listening, speaking, reading, writing, grammar and vocabulary/concept learning are factors which may affect his/her achievements not only in these areas but also in other study areas which eventually affects his/her social life status directly/indirectly. Accordingly, it is important that students should be introduced with correct strategies at schools. McKnight (2010, p. 1) defends that in today's classes, nothing is more necessary than teaching with strategies for successful teaching and learning. Graphic organizers, at this point, have characteristics which are formed on the basis of cognitive learning strategies and correspond with modern learning strategies such as constructivist approach and brain-based learning at the same time. In the report published by National Center on Accessing the General Curriculum it is expressed that graphic organizers are quite effective in enhancing the learning outcomes of all students. When these tools are designed suitably with developmental characteristics of students, they enable them to be active participants of their own learnings. Graphic organizers provide children with opportunities to check their learning process by exploring how to build concept and knowledge (Strangman, Hall, & Meyer, 2003). Therefore, these tools are used at all educational levels from pre-school level to undergraduate.

Recommendations & Limitations

Findings of this study have illustrated that graphic organizers are considerably effective on academic success compared with traditional teaching methods. As this study is limited with meaning map, knowledge map, computer-based graphic organizer, concept map, K-W-L and mind map, more studies should be conducted which will include other graphic organizer types in the research. In all quasi-experimental/experimental studies which investigate effects of graphic organizers on improvement of language skills and academic success, reporting effect sizes, duration of practice or reporting statistical data required for effect size measures shall ensure that meta-analysis study can produce more extensive and reliable results. Additionally, in meta-analysis studies, more studies should be conducted which will examine the effect of graphic organizers not only on academic success but also on dependent variables like attitude and motivation.

This study has some certain limitations. First of all, this meta-analysis consists of studies which are reported only in Turkish and English languages. This issue might affect the realibility of study negatively because it may cause language bias. Also, concentration of a considerable part of studies in this meta-analysis on one specific type of graphic organizer, reading-writing learning areas and at undergraduate-secondary education level; results in representation of other factors with fewer number of studies in intervening variable analysis. Therefore; an increase in experimental studies in other areas of language learning like speaking, listening and grammar is important in terms of possibility of later meta-analysis studies to produce more generalizable results. Also, reporting certain qualities such as learning style, age and gender in studies in which graphic organizers are used as experimental intervention instrument, allows conducting different intervening variable analysis and making a comparative analysis of effects.

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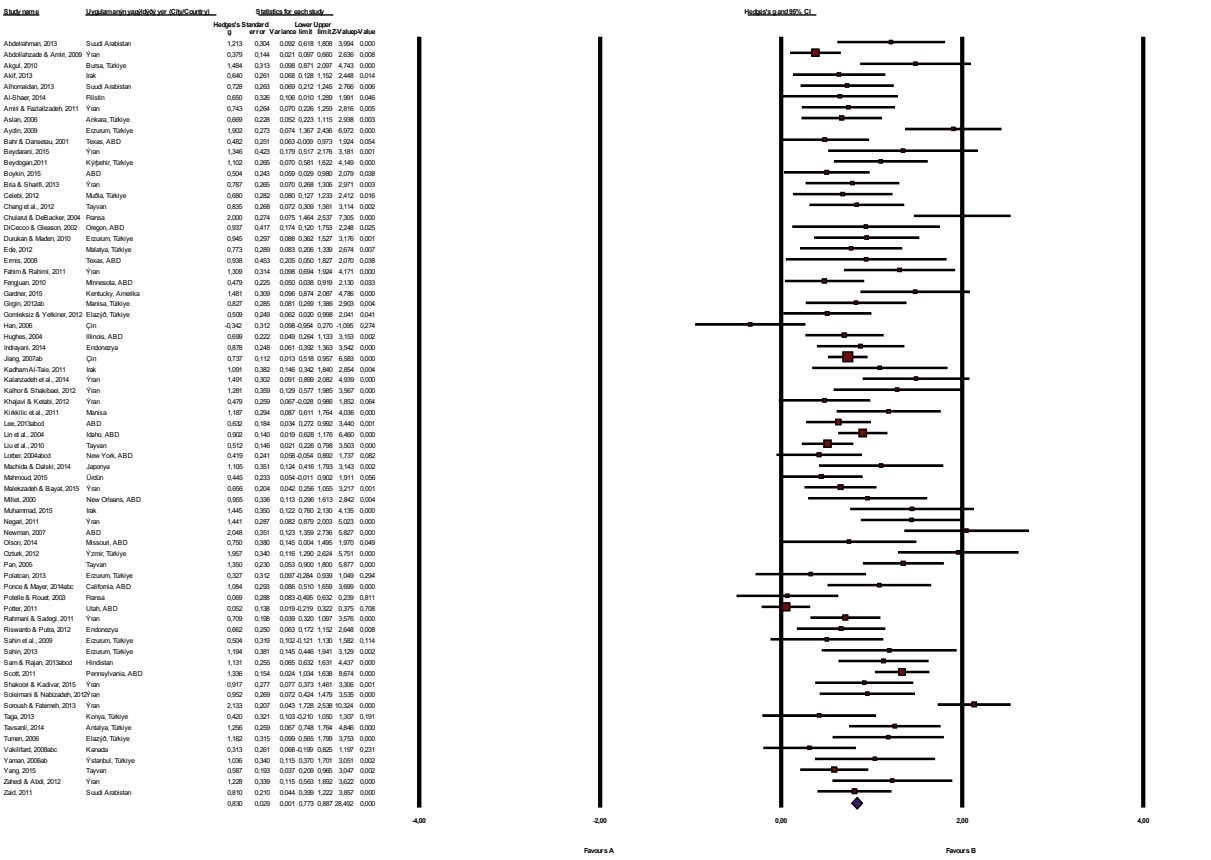
Appendix 1

The distribution of upper and lower limit values for effect sizes in 95% confidence interval according to random effect size model for the difference between winsorized mean and standardized mean, Hedge's g effect size index, standard error, variance and *p* values belonging to the experimental studies which examines the effect of graphic organizers on students' academic success in the basic language skills areas.



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