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USING GRAPHIC ORGANIZERS TO TEACH CONTENT AREA MATERIAL TO STUDENTS WITH LEARNING DISABILITIES

A Dissertation in

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by

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ABSTRACT

A pretest-posttest comparison group design was used to investigate the effects of a semantic mapping lesson plus visual display versus a semantic mapping lesson alone on adolescents with learning disabilities (LD) ability to gain and maintain factual knowledge from expository social studies material. In addition, a posttest only comparison group design was used to examine the effects of the semantic mapping lesson plus visual display versus a semantic mapping lesson alone on adolescents with LD far-transfer ability. The results of this study supported the conclusion that semantic mapping was beneficial for factual recall, while the additive effect of a visual display significantly improved maintenance and far transfer for adolescents with LD. Results of this study also supported the conclusion that normally achieving students and low achieving students also benefit from semantic mapping and the visual display. This finding was consistent over written and multiple-choice measures. Implications for practice and future research are discussed.

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As wampeter of my karass, Charlie Hughes has been stellar. I could not have imagineered a more outstanding mentor and friend. As it is difficult to eloquently articulate just how much he has meant to me, I will leave it at this - he is like a picnic in the rain after a prairie fire.

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When I first arrived at Penn State, I felt like Chaerephon after visiting the Oracle of Delphi – he learned that no one in Greece was as wise as Socrates. I was soon to learn that no one at Penn State is as wise as Kathy Ruhl. At first, her dialectical methods made me wonder, “Why won’t she just answer my question?” But, soon I realized how important these sessions were to my thinking about special education. She has instilled in me that, for teaching advanced students, “education is the kindling of a flame, not the filling of a vessel.” Very Socratic, indeed!

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Erleichda!

--Tom Robbins, *Jitterbug Perfume*

Chapter 1

Introduction

As students enter the intermediate and secondary grades, academic demands are heightened as material becomes more complex and curriculum is driven by higher-order skills and advanced concepts (Fletcher, Lyon, Fuchs, & Barnes, 2007). These students typically receive less individual attention as in primary grades (Hughes, Maccini, & Gagnon, 2003) and are often required to learn primarily through didactic lecture and expository text presentation (Gajria, Jitendra, Sood, & Sacks, 2007; Minskoff & Allsopp, 2003). This shift in learning presentation, rife with abstract concepts, unfamiliar content, and technical vocabulary (Armbruster, 1984), may seem daunting to most students, but is especially so to students with learning disabilities (LD).

Students with LD often have difficulty with basic academic skills (e.g., reading) and organizational/study skills (Deshler, Ellis, & Lenz, 1996). Specifically, students with LD generally have difficulty connecting new material to prior knowledge, identifying and ignoring extraneous information, identifying main ideas and supporting details, drawing inferences, and creating efficient problem-solving strategies (Kim, Vaughn, Wanzek, & Wei, 2004; Baumann, 1984; Williams, 1993; Holmes, 1985; Johnson, Graham, and Harris, 1997). Because many textbooks are written above grade level reading ability and lack organizational clarity (Gajria et al., 2007), these learning difficulties make interpreting and comprehending expository text especially challenging (Bryant, Ugel, Thompson, & Hamff, 1999). Students with LD need explicit content enhancements to assist in verbal (e.g., text or lecture) comprehension and graphic organizers (GOs) have often been recommended as an instructional device to assist these students in understanding increasingly abstract concepts (Kim et al., 2004; Ives & Hoy, 2003; Bos & Vaughn, 2002; Hughes et al., 2003; Nesbit & Adesope, 2007; Rivera & Smith, 1997).

GOs are visual and spatial displays that make relationships more apparent between related facts and concepts (Hughes et al., 2003; Kim et al., 2004; Gajria et al., 2007). They are intended to promote more meaningful learning and facilitate understanding and retention of new material by making abstract concepts more concrete and connecting new information with prior knowledge (Ausubel, 1968; Mayer, 1979). GOs can be used before, during, and/or after a student attends to verbal (e.g., text or lecture) stimuli (Nesbit & Adesope, 2006).

Theoretical Framework for GOs with Students with LD

The theory of subsumption (Ausubel, 1960) and assimilation theory (Mayer, 1979) both offer direct implications about the possible benefits of GOs in learning. These two theories provide the basis for how GOs are able to help facilitate understanding of unfamiliar material and clarify relationships between abstract concepts. (A theoretical review of GOs in its entirety is found in Appendix A).

The research findings of both the theory of subsumption and assimilation theory appear to have specific implications for students with LD, although neither theory focused on this group of students. Specifically, students with LD may benefit more from GOs than their non-disabled peers. A consistent pattern that emerged from the research on these theories is that students displaying lower verbal ability demonstrated larger gains than did students with average or high verbal ability, and these gains helped the students with lower verbal ability match the scores of peers with average verbal ability. As addressed earlier, students with LD typically have low verbal ability (Kim et al., 2004) that often manifests itself as difficulty in connecting new material to prior knowledge (Williams, 1993). This is because, according to Mayer (1979), the specific structure of a GO may guide construction of cognitive structures in less knowledgeable students, but may conflict with pre-existing cognitive structures in more knowledgeable students.

Students with LD also typically perform poorly on far-transfer tasks (e.g., applying knowledge to new or unusual situations) due to their inability to detect underlying concepts in verbal information (Suritsky & Hughes, 1991). Based on the above theories, this may be due to difficulty assimilating verbal information with previous knowledge. The research evidence of the assimilation theory suggests GOs may be the bridge in connecting verbal information with prior knowledge. This may dramatically assist students with LD in far-transfer tasks.

In addition, based on the visual argument hypothesis (Waller, 1981), Larkin and Simon (1987) concluded only "computationally efficient" (e.g., relationships more explicit than implicit) displays are effective for learning. Based on research published since Larkin and Simon's seminal work, other researchers have found patterns that support specific design principles that may achieve computational efficiency (McCrudden, Schraw, Lehman, & Poliquin, 2007; Robinson, Katayama, Dubois, & Devaney, 1998; Robinson & Skinner, 1996; Robinson & Kiewra, 1995; Robinson & Schraw, 1994). A general principle is that GOs are effective when they address the limitations of working memory in their design. This is consistent with the work of Swanson and Kim (2005) who found students with LD performed significantly better on problem solving tasks when stress on the working memory was minimized.

Research Base for GOs with Students with LD

A comprehensive meta-analysis of research studies examining GOs with secondary students with LD is found in Appendix B. Based on this meta-analysis, the major implication for applied practice is, consistent with assimilation theory and the visual argument hypothesis; more instructionally intensive types of GOs (e.g., semantic maps) are better for immediate factual recall while more computationally efficient GOs (e.g., visual display) are better for maintenance and transfer. This knowledge can help teachers in designing GOs for initial instruction and for re-teaching, studying, and retention purposes. For instance, a semantic map for initial instruction, followed by a simpler visual display for review and study will potentially maximize the effects of recall, maintenance, and far-transfer for students with LD.

Semantic mapping (SM) is a heuristic that enables students to recognize relevant information from lecture and text (e.g., main ideas, important supporting details) and organize that information for written or oral retell (Washington, 1988). In SM, students and/or the teacher create a visual representation of new or difficult vocabulary and any relationships existing among the different vocabulary (Bos & Anders, 1992). In addition, when teaching this type of GO, a teacher presents critical attributes of a concept along with examples and non-examples to help promote student discrimination and generalization (Deshler et al., 1996).

Visual displays present concepts or facts spatially, in a computationally efficient manner. That is, relationships between concepts are made apparent and clear by their location on the display. According to Hughes et al. (2003), in a visual display, facts or concepts are typically presented in one of five ways: temporal (e.g., timeline), spatial (e.g., decision tree), sequential (e.g., flowchart), hierarchal (e.g., taxonomy), or comparative (e.g., Venn diagram).

Study Purpose

The purpose of this proposed study is to replicate and extend the current evidence of the effectiveness of GOs with students with LD. While it has been hypothesized that visual displays will assist with maintenance and far transfer for students with LD (Vekiri, 2002; Robinson, Katayama, Dubois, & Devaney, 1998; Robinson & Skinner, 1996; Mayer, 1979), it has not been directly tested. Given that students with LD have difficulty with maintenance and far transfer (Gajria et al., 2007; Kim et al., 2004; Baumann, 1984; Williams, 1993; Holmes, 1985; Johnson et al., 1997), it is important to attempt to validate this hypothesis. Specifically, this study will answer the following questions:

1. What is the effectiveness of a semantic mapping lesson compared to a semantic mapping lesson plus a visual display in improving factual recall during social studies verbal instruction for adolescent students with LD?
2. Does the addition of a visual display to the semantic mapping lesson improve maintenance effects for adolescent students with LD?
3. Does the addition of a visual display to the semantic mapping lesson improve far transfer effects for adolescent students with LD?

Study Hypotheses

Based on the review of theory and meta-analysis of studies of GOs, both the experimental (SM + visual display) and control group (SM only) of students with LD and low achieving students should demonstrate a large effect between pretest and posttest.

However, the SM + visual display condition should perform significantly higher on tests of maintenance and far transfer.

Chapter 2

Methods

Experimental Design

A pretest-posttest comparison group design was used to investigate the effects of an SM lesson plus visual display versus an SM lesson alone on students' ability to gain and maintain factual knowledge from expository social studies material. In addition, a posttest only comparison group design was used to examine the effects of the SM lesson plus visual display versus an SM lesson alone on students' far-transfer ability. Stratified purposeful sampling was used to divide the students into three groups: (a) normally achieving; (b) students with LD; and (c) low-achieving. Once these groups were determined, students were randomly assigned to the treatment (SM + visual display) or control (SM only) groups.

Participants and Setting

The study took place in a rural school district in the eastern United States. Three eighth grade social studies inclusion classrooms were selected for the study based on their high density of students with LD. Out of a total of 76 students, parental and student informed consent was obtained for 62 students (IRB #33473). Appendix C contains the informed consent form. Nineteen of these students were identified as having a specific learning disability in reading (e.g., basic skills, fluency, and/or comprehension), 36 students were normally-achieving, and seven students were selected by the classroom teacher as being low-achieving. The demographics of the 62 participating students were similar to the district as a whole. Thirteen participants received free or reduced lunch, similar to the 24% of the entire district. Fifty-five of the students were Caucasian, four were African American, and three were Hispanic. Twenty-eight of the students were female and thirty-three were male. Across treatment and control conditions, independent *t*-tests demonstrated no significant differences between groups on demographics (see Table 1).

Table 1. *Participant Characteristics by Treatment Conditions by Total*

	Condition		
Characteristics	SM + Visual Display	SM Only	Total
Number of Participants	33	29	62
Normally-Achieving Students	19 m = 10, f = 9	17 m = 7, f = 10	36
Students with LD	10 m = 6, f = 4	9 m = 5, f = 4	19
Low-Achieving Students	4 m = 3, f = 1	3 m = 2, f = 1	7
Chronological Age			
M	170.20	167.46	168.92
SD	6.67	5.92	6.32
Economic Status			
Free/reduced lunch (*n*)	8	5	13
Race			
African American (*n*)	3	1	4
Caucasian (*n*)	29	26	55
Hispanic (*n*)	1	2	3

Note. SM = semantic mapping. Chronological age stated in months as of April 20, 2010.

Students with LD. Nineteen students were designated as having a primary, specific learning disability in reading. Each of these 19 students received their social studies instruction in the general education classroom. However, 12 of the 19 students with LD received a pullout service accommodation with a trained special educator for passage reading and test taking. The special educator would read the passages and tests aloud to these 12 students. The mean full-scale IQ across the 19 students with LD was

95.86 (Wechsler Intelligence Scale for Children – Third Edition, 1991; WISC-III). The mean composite reading achievement score across the 19 students with LD was 79.46 (Woodcock-Johnson III Tests of Achievement, 2001; WJ-III). In addition to the primary learning disability in reading, 12 students also had comorbid conditions - three students had a disability in an area of mathematics (MD), seven students were identified as having attention-deficit/hyperactivity disorder (AD/HD), and two students were identified with both MD and AD/HD. Across treatment and control conditions, independent *t*-tests demonstrated no significant differences between the groups of students with LD on their unique characteristics (see Table 2).

Table 2. *Students with LD Characteristics by Treatment Conditions by Total*

Characteristics	SM + Visual Display (Condition)	SM Only (Condition)	Total (Condition)
Number of Students with LD	10	9	19
Sex			
Male	6	5	11
Female	4	4	8
IQ score (Full scale WISC-III)			
M	95.2	96.6	95.86
SD	8.3	9.1	8.68
Reading Achievement (WJ-III)			
M	78.7	80.3	79.46
SD	7.5	7.9	7.69
Pullout Service (*n*)	7	5	12
Comorbid Conditions			
MD (*n*)	2	1	3
AD/HD (*n*)	4	3	7
MD + AD/HD (*n*)	1	1	2

Note. Scores obtained from school files and were based on tests administered by school personnel within the previous four years. MD = mathematics disability, AD/HD = attention-deficit/hyperactivity disorder, SM = semantic mapping.

Low-achieving students. The classroom social studies teacher selected seven students as low achieving. The teacher's designation of low-achievement was based on five factors: (a) perceived discrepancy between performance and potential; (b) low academic self-concept; (c) little value placed on short-term or long-term goals; (d) little or no motivation for learning; and (e) a general negative attitude toward school and teachers. These factors closely relate to characteristics identified in the research literature examining low-achievers (McCoach & Siegle, 2001; Schunk, 1998; Ford, 1996). None of the seven students identified as low-achievers received any type of additional support outside of the general education classroom. Data from IQ tests and achievement tests for the low-achieving group were unavailable to the researcher.

Teacher/Researcher. To ensure authenticity, all instruction was provided in the general education classroom at the normal time for each of the three classes. The classroom was a standard size with individual student desks arranged in rows facing a front chalkboard. The primary researcher, with five years experience as a special and regular education teacher, served as the instructor for each of the classes. The classroom teacher remained in the room during each class period, but was situated behind and out of sight from the students.

Materials

Prior to the study, in collaboration with a content expert (e.g., B.A. in history; state certified social studies teacher) and the classroom teacher with 29 years of eighth grade social studies teaching experience, the primary researcher selected *Feudalism in Middle Ages Europe* as the lesson topic for the study. This topic was derived from a ninth grade state standard, one year above the student level in this study. The ninth grade state standard was selected for content validity purposes (e.g., actual content the students are expected to learn in the future) and to mitigate the chances of prior knowledge affecting the study outcomes.

After selection of the topic, the social studies content expert created an expository passage to be used for instruction (appendix D). The passage was 546 words and fell on a 6.4 grade level based on a readability test. The Lexile level was 860L, which equals approximately a late sixth grade or early seventh grade reading level. The rationale to go below grade level was based on classroom practice. The classroom teacher reported most passages used for instruction over the course of the year fell in the 6 to 7.5 grade level range. The text structure of the passage was hierarchical, based primarily on the overall social structure of feudal times, as well as hierarchies within individual social levels. For example, a knight fell below a noble on the overall social structure of feudal times and within the knight level there existed a hierarchy including pages and squires.

Based on the expository passage, the primary researcher created an SM lesson wherein the instructor and students (both treatment and control groups) created a semantic map together. Following the suggestions of Gersten et al. (2005), the lesson was fully scripted to increase the likelihood of fidelity over the three class periods.

Prior to posttest, the treatment condition (SM + visual display) received a researcher-created visual display to study for 10 minutes. The control group (SM only) was only allowed to study the semantic map they created. The visual display provided to the treatment group is illustrated in Figure 1.

Feudalism Hierarchy

Nobles

Kings and queens; only 10% of population
Lived in cold, drafty castles

Knights

sons of nobles;
3 stages to become a Knight =
1. Page (learned chivalry),
2. Squire (learned to ride and fight),
3. Knight

Vassals

lesser nobles;
granted fief (land) for promise to fight for the nobles

Peasants

limited rights;
could operate private business

Serfs

slaves; no rights

Figure 1. Visual Display

Overview of Instruction

The SM lesson was delivered based on the recommendations of Washington (1988) and included: (a) brief introduction; (b) questions and/or predictions; (c) vocabulary overview; (d) stated purpose; (e) reading the passage; (f) brainstorming; and (g) creating the map. Both treatment and control groups were taught concurrently and received the same amount of instruction. Each lesson lasted the fully allotted 45-minute class period.

Brief introduction. The brief introduction served as a connection between the students' background knowledge and the information they would be learning. For each of the three classes, the researcher introduced the concept of feudalism in Middle Ages Europe as a development resulting from constant attacks by Vikings and other nomadic tribes. Further, the researcher explained, with governments and economies in shambles, feudalism was developed primarily to provide adequate protection from outside forces.

Questions and/or predictions. After the introduction, students were allowed to ask questions about anything they were curious about or make predictions about the passage. Across the three classes, no predictions were made. However, several common questions were raised and were consistent across the classes (e.g., Is this when knights were around?; Is this when kings and queens would rule everybody from their castle?). There was no potentially confounding student question or insight that might have given advantage to one class over another.

Vocabulary overview. Prior to the lesson, the social studies content expert and the classroom teacher identified 13 words from the passage they felt held significance for the lesson and might have been unfamiliar to the students. The vocabulary list included:

feudalism, noble, peasant, knight, page, chivalry, squire, vassal, fief, manor, serf, moat, and waterwheel. These words were listed on the blackboard in the order they were mentioned in the passage. The researcher elicited strategies from the students for deriving meaning from unfamiliar vocabulary. Unanimously, over the three classes, was the response "context clues."

Stated purpose. Just prior to reading the passage, the researcher explicitly stated the purpose of the lesson. Specifically, the researcher stated to the class, "For this lesson, the purpose is to recall facts and ideas about feudalism in Middle Ages Europe. I want you to remember as many details from the passage as you can."

Reading the passage. Based on the knowledge that 12 students across the three classes received pullout instruction for passage reading and test taking, the researcher read the passage aloud to each of the classes. Prior to the lesson, the researcher formulated the main idea for each paragraph of the passage and the common definitions to be used for each of the 13 identified vocabulary words. After reading each paragraph, the researcher stopped and asked the class, "Okay, what was this paragraph about?" After students would give responses, the researcher would elaborate and firm up knowledge by explicitly stating the main idea. The same method was used for the identified vocabulary words. For example, "Here is the second word from our vocabulary list, noble. Class, who can tell me what this word means?" After student responses using context clues, the researcher would firm up by explicitly stating his common definition. The common main ideas and common vocabulary were used to increase fidelity of implementation across the three classes.

Brainstorming. After reading the passage to the students, the researcher asked the students to brainstorm any facts or ideas they recalled from the lesson. The researcher urged the students to not directly quote from the passage, but to put the ideas in their own words. As the students called out facts and ideas, the researcher wrote them on the blackboard with no distinction made between types of facts or ideas (e.g., main, subordinate, etc.).

Creating the map. After the students ran out of ideas or facts to add to the list, the researcher informed the students, “It is now time to create our semantic map.” The researcher drew a circle in the center of the blackboard and instructed the students to do the same on their notebook paper. The researcher continued, “What was the overall main idea about the passage we read?” Across the classes, the answer was a consistent, “feudalism.” The researcher instructed the students to write the word in the circle and then prompted the students to remember and write the definition for feudalism developed in the lesson. This type of prompting continued for the entire student-generated list of facts and ideas. The researcher would provide leading questions, such as “Which facts go together because they are about the same idea?” Colored chalk was used to highlight groups of ideas. “What can we call this group of ideas?” The students would then fill in their semantic maps while the researcher did so on the blackboard. Prior to the lesson, the researcher identified the main idea (e.g., feudalism) and three subordinate ideas (e.g., people, land, innovations) from the passage. The researcher was prepared to lead the students to these ideas if they struggled, but each class was able to come to the same concepts on their own. A typical student-created semantic map from the lesson has been reproduced in Figure 2.

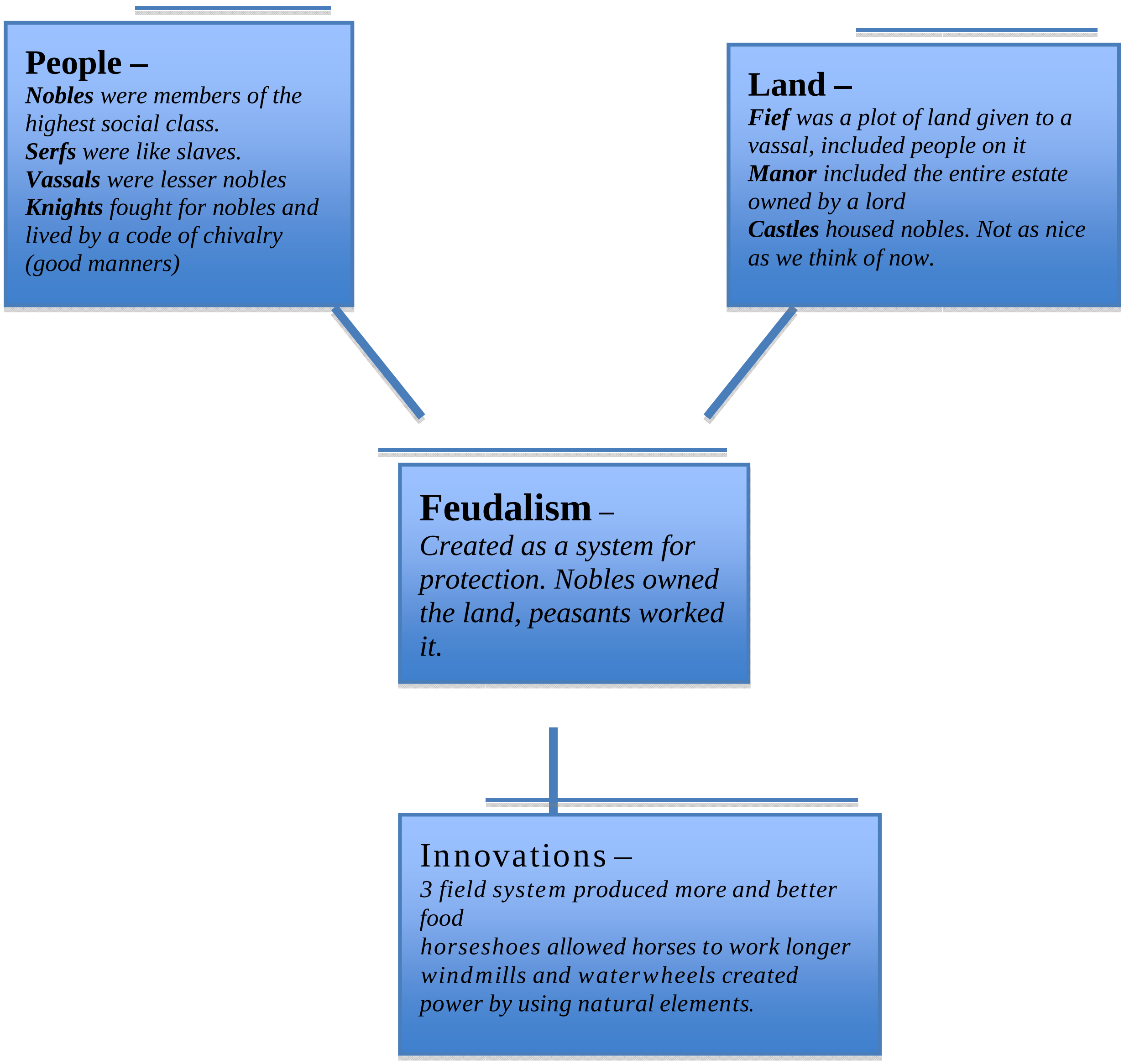


Figure 2. Completed Semantic Map

Fidelity of implementation. The three class sessions were audio recorded to verify instruction was delivered in the same manner for each class. Within the week following instruction, the primary researcher and a graduate research assistant separately analyzed the audio recordings with a copy of the lesson script. Special attention was given to adherence to the script, wording of definitions, and points emphasized. No major discrepancies in instruction were uncovered between classes. The major difference between each class was the student questions and responses. These varied somewhat by class, but it was determined the researcher was able to successfully guide each class back to common anchoring points in adherence with the script.

Measures

Multiple measures were used at pretest, posttest, and maintenance to test the factual recall of all students in the study - a written factual recall measure and multiple-choice measure. At each time of testing, the written factual recall measure preceded the multiple-choice measure so the information in the multiple-choice test did not influence the written recall. Additionally, at posttest and maintenance, a five-question multiple-choice measure was added to test student's far-transfer ability.

Written factual recall. A written factual recall measure was used at pretest, posttest, and maintenance. Due to school district policy and request, the written factual recall measure was not a straight retell measure. The district literacy experts insisted the students use a five-paragraph essay outline worksheet for this measure (appendix E). The worksheet provided a space for a main idea (e.g., thesis), three subordinate ideas, three details for each subordinate idea, and a conclusion statement. The students had much experience working with this worksheet and in other classes were encouraged to fill out the main and subordinate ideas before adding any details. As such, the students understood what to do when told to write in "five paragraph essay form."

Each time this measure was used (e.g., pretest, posttest, maintenance), the researcher instructed the students to "Write everything you know about feudalism in

Middle Ages Europe in five paragraph essay form. Please write in complete sentences." Because of time constraints on each testing day, total time allowed for the written factual recall measure was seven minutes.

The scoring of the written factual recall measure was based on the worksheet. One point was given for each reasonable and correct component (e.g., main idea, subordinate ideas, subordinate details) written in a complete or partial sentence. For example, in the case of an overall thesis statement, "Feudalism in Middle Ages Europe developed out of a need for protection and security" or "Feudalism about land and protection" earned one point; while "Feudalism contained lots of people" earned no points.

Multiple - choice. A multiple-choice measure containing 20 factual recall items was also used at pretest, posttest, and maintenance. This measure was developed by the social studies content expert based on the expository passage and the primary researcher was blind to the items on the test during creation of the scripted lesson. However, like the expository passage, the multiple-choice test was read aloud to the students. Because of this, the researcher was aware of the test items after pretest and before instruction, but the lesson script was not altered in any form. The same test was used at posttest and maintenance, but the questions and answer choices were randomly reordered before each subsequent testing.

The multiple-choice pretest was also used to test the internal consistency of the measure and control for prior knowledge. Because each of the items was dichotomously scored (e.g., 0 for incorrect, 1 for correct), the Kuder-Richardson 20 (KR-20) formula was used to determine internal consistency (e.g., how consistent subject responses are among the questions on an instrument). A reliability coefficient of .81 indicated individual test items produced similar patterns of responding across all participants. This confirmed the test items were homogenous and reliable for the pretest and alternate forms (e.g., posttest, maintenance).

To control for prior knowledge, any participant with more than 12 items correct at pretest would be excluded from the study. No participants were excluded for this reason (e.g., pretest range was 3 – 11 items correct).

Far-transfer. Five multiple-choice questions were added to the posttest and maintenance test to measure students' ability to answer far-transfer items (e.g., similar relational content not covered in the lesson). For example, a sample question was "Similar to chivalry, bushido was the Japanese code of which group? (a) Geisha (b) Samurai (c) Rulers (d) Priests." The social studies content expert created the far-transfer items and they were interspersed with the 20 factual recall items.

Scoring and reliability. Initially, the primary researcher scored the written factual recall measures and multiple-choice tests. Afterwards, the researcher coded each measure from 1 – 62 and had two graduate research assistants score each measure for reliability purposes. The coding ensured the graduate students would be blind to condition and student name. For the written factual recall, 83% reliability was obtained initially between the three scorers. After discussion and reexamination between the scorers, the reliability increased to 95%. For the multiple-choice measures, reliability was 100%.

Social Validity. A student attitude measure allowed students to indicate how they felt about the instruction they received. Using a measure previously developed and tested (e.g., Darch & Carnine, 1986; Darch & Gersten, 1986; Darch, Carnine, & Kameenui, 1986), all subjects rated instruction (e.g., 5-point Likert scale) on three dimensions: how much they learned, whether they liked the SM lesson, and whether they liked studying with the visual display (treatment) or semantic map (control). This measure provided data on the social validity of the experiments.

Chapter 3

Results

Written Factual Recall

Pretest – posttest. Descriptive and statistical data for the pretest and posttest written factual recall measure are displayed in Table 3. The *F*-statistic was a result of one-way analysis of variances (ANOVAs) used as significance testing between mean gain by condition.

Table 3. *Pretest – Posttest Written Factual Recall*

	Pretest		Posttest			
Condition	*M*	*SD*	*M*	*SD*	*Mean Gain*	*F*
SM + Visual Display *Overall, N* = 33	.51	.53	4.54	1.03	+4.03	10.01**
SM Only *Overall, N* = 29	.55	.69	3.64	1.27	+3.09	
Disaggregated by Student Type						
SM + Visual Display *Students with LD, N* = 10	.10	.32	4.10	.74	+4.00	25.59***
SM Only *Students with LD, N* = 9	.22	.44	2.89	.78	+2.67	
SM + Visual Display *Low Achieving Students, N* = 4	0	0	2.25	.50	+2.25	*n.s.*
SM Only *Low Achieving Students, N* = 3	0	0	1.67	.58	+1.67	
SM + Visual Display *Normally Achieving, N* = 19	.84	.76	5.26	1.66	+4.42	5.30*
SM Only *Normally Achieving, N* = 17	.82	.95	4.29	1.57	+3.47	

Note. *** = $p < .001$, ** = $p < .01$, * = $p < .05$

Overall, across student type and condition, students averaged less than one correct written statement at pretest. After disaggregating the data, it is shown that students with LD averaged only .16 correct written statements and low achieving students produced no correct written statements at pretest. Mean gains between pretest and posttest favored the SM + visual display group in all categories of students, but most significantly with students with LD, $F(1, 17) = 25.59$, $p < .001$.

Posttest and maintenance only. Results of the written factual recall measure were also analyzed for effect sizes (*ES*s) at posttest and maintenance. Effect sizes here and in subsequent analyses are reported as Cohen's *d* (> .2 = small effect, > .6 = moderate effect, > .8 = large effect). In addition, one-way ANOVAs were used for significance testing. Overall results by condition are displayed in Table 4.

Table 4. *Overall Written Factual Recall Posttest and Maintenance Only Effects by Condition*

	SM +Visual Display		SM Only			
Measure	*M*	*SD*	*M*	*SD*	*ES*	*F*
Posttest	4.54	1.03	3.64	1.27	.78	9.28**
Maintenance	4.94	1.28	3.45	1.32	1.15	18.03***
	N = 33		*N* = 29			

Note. *ES* = Effect size. Both effect sizes in favor of the SM + visual display group. ***$p < .001$, **$p < .01$

A moderate *ES* favoring the SM + visual display condition was found for posttest, while a strong *ES* was found for maintenance. These effects were both statistically significant. Of note, the mean number of correct written factual statements increased between posttest and maintenance for the SM + visual display condition, while it decreased for the SM only condition. Thus, a larger effect for maintenance was demonstrated across all students. These data were also disaggregated by student type. The results are displayed in Table 5.

Table 5. *Disaggregated Written Factual Recall Posttest and Maintenance Only Effects by Condition*

	SM +Visual Display		*SM Only*			
Group/Measure	*M*	*SD*	*M*	*SD*	*ES*	*F*
Students with LD						
Posttest	4.10	.74	2.89	.78	1.59	11.78**
Maintenance	4.00	.67	2.67	1.12	1.46	9.85*
	N = 10		*N* = 9			
Low Achieving Students						
Posttest	2.25	.50	1.67	.58	1.09	*n.s.*
Maintenance	2.50	.58	2.33	.58	1.29	*n.s.*
	N = 4		*N* = 3			
Normally Achieving Students						
Posttest	5.26	1.66	4.29	1.57	.60	*n.s.*
Maintenance	5.95	1.75	4.06	1.56	1.14	11.95**
	N =19		*N* = 17			

Note. *ES* = Effect size. All effect sizes in favor of the SM + visual display group.
$**p < .01$, $* p = < .05$

Effects favored the SM + visual display group across each student type for posttest and maintenance. Students with LD demonstrated the largest effects for posttest and maintenance, both strong (e.g., > .8) and statistically significant. Low achieving students displayed large effects, but due to such small sample sizes the effects were not statistically significant. The normally achieving group demonstrated a strong, statistically significant effect for maintenance only. In terms of correct written factual statements, students with LD were the only group whose mean number decreased between posttest and maintenance. The low achieving and normally achieving groups both saw an increase between posttest and maintenance for the SM + visual display condition.

Multiple-Choice Factual Recall

Pretest – posttest. Descriptive and statistical data for the pretest and posttest multiple-choice factual recall measure are displayed in Table 6. The *F*-statistic was a result of one-way ANOVAs used as significance testing between mean gain by condition.

Table 6. *Pretest – Posttest Multiple-Choice Factual Recall*

	Pretest		Posttest			
Condition	*M*	*SD*	*M*	*SD*	*Mean Gain*	*F*
SM + Visual Display *Overall, N* = 33	7.24	2.44	14.85	3.05	+7.61	4.31*
SM Only *Overall, N* = 29	7.55	2.15	13.76	2.91	+6.21	
Disaggregated by Student Type						
SM + Visual Display *Students with LD, N* = 10	6.70	1.89	13.80	1.81	+7.10	*n.s.*
SM Only *Students with LD, N* = 9	6.56	1.74	13.44	1.81	+6.88	
SM + Visual Display *Low Achieving Students, N* = 4	5.25	1.71	11.00	1.83	+5.75	*n.s.*
SM Only *Low Achieving Students, N* = 3	6.00	2.00	9.67	3.06	+3.67	
SM + Visual Display *Normally Achieving, N* = 19	7.95	2.59	16.21	2.92	+8.26	5.01*
SM Only *Normally Achieving, N* = 17	8.35	2.09	14.65	2.83	+6.30	

Note. * = $p < .05$

Overall, across student type and condition, students averaged 7.4 correct answers (out of 20) at pretest on the multiple-choice factual recall measure. The average increased to 14.31 correct answers (out of 20) at posttest. Across all students, there was a significant difference in mean gain, $F(1, 60) = 4.31$, $p < .05$, favoring the SM + visual display group. After disaggregating the data, mean gains between pretest and posttest favored the SM + visual display group in all categories of students, but most significantly with the normally achieving group, $F(1, 34) = 5.01$, $p < .05$.

Posttest and maintenance only. Results of the multiple-choice factual recall measure were also analyzed for *ES*s at posttest and maintenance. In addition, one-way ANOVAs were used for significance testing. Overall results by condition are displayed in Table 7. The means are out of a total of 20 possible items.

Table 7. *Overall Multiple-Choice Posttest and Maintenance Only Effects by Condition*

	SM +Visual Display		*SM Only*			
Measure	*M*	*SD*	*M*	*SD*	*ES*	*F*
Posttest	14.85	3.05	13.76	2.91	.33	*n.s.*
Maintenance	13.55	3.25	11.14	2.81	.78	9.62**
	N = 33		*N* = 29			

Note. *ES* = Effect size. Both effect sizes in favor of the SM + visual display group.
**$p < .01$

A small *ES* favoring the SM + visual display condition was found for posttest, although it was not statistically significant. However, a significant moderate effect was found for maintenance across all students favoring the SM + visual display condition. The mean correct number of multiple-choice items between posttest and maintenance decreased by 1.3 in the SM + visual display group, while the decrease was 2.62 items for the SM only group. These data were also disaggregated by student type. The results are displayed in Table 8.

Table 8. *Disaggregated Multiple-Choice Posttest and Maintenance Only Effects by Condition*

	SM +Visual Display		SM Only			
Group/Measure	*M*	*SD*	*M*	*SD*	*ES*	*F*
Students with LD						
Posttest	13.80	1.81	13.44	1.81	.22	*n.s.*
Maintenance	13.40	1.78	11.00	1.58	1.41	9.57**
	N = 10		*N* = 9			
Low Achieving Students						
Posttest	11.00	1.83	9.67	3.06	.55	*n.s.*
Maintenance	9.50	3.70	6.67	2.08	.89	*n.s.*
	N = 4		*N* = 3			
Normally Achieving Students						
Posttest	16.21	2.92	14.65	2.83	.56	*n.s.*
Maintenance	14.47	3.22	12.00	2.74	.84	6.07*
	N =19		*N* = 17			

Note. *ES* = Effect size. All effect sizes in favor of the SM + visual display group.
**p < .01, * p = < .05

Effects favored the SM + visual display group across each student type for posttest and maintenance. For posttest, all effects were small. However, for maintenance, all effects were strong and statistically significant for students with LD and normally achieving students. Students with LD demonstrated the largest effects for maintenance, a robust 1.41. Low achieving students displayed a large effect for maintenance, but it was not statistically significant. Of particular note, the students with LD in the SM + visual display group only decreased by .4 items correct between posttest and maintenance, while the SM only group decreased by 2.44 items correct. The students with LD in the SM + visual display condition had the highest level of maintenance in relation to posttest scores of the three groups of students.

Far Transfer

Posttest and maintenance only. Results of the multiple-choice far transfer measure were analyzed for *ES*s at posttest and maintenance. In addition, one-way ANOVAs were used for significance testing. Overall results by condition are displayed in Table 9. The means are out of a total of five possible items.

Table 9. *Overall Far Transfer Effect by Condition*

	SM +Visual Display		*SM Only*			
Measure	*M*	*SD*	*M*	*SD*	*ES*	*F*
Far Transfer	3.33	1.11	2.72	1.19	.53	4.36*
Maintenance	3.21	.89	2.31	1.26	.83	16.80***
	N = 33		*N* = 29			

Note. *ES* = Effect size. Both effect sizes in favor of the SM + visual display group.
*** = $p < .001$, * = $p < .05$

A statistically significant moderate *ES* favoring the SM + visual display condition was found for posttest. In addition, a significant strong effect was found for maintenance across all students, also favoring the SM + visual display condition. The difference between mean correct numbers of far transfer items between conditions was .61 at posttest and increased to .9 at maintenance. These data were also disaggregated by student type. The results are displayed in Table 10.

Table 10. *Disaggregated Far Transfer Effect by Condition*

	SM +Visual Display		SM Only			
Group/Measure	*M*	*SD*	*M*	*SD*	*ES*	*F*
Students with LD						
Far Transfer	3.51	.85	2.11	.78	1.70	13.88**
Maintenance	3.32	.67	1.78	.97	1.84	16.51***
	N = 10		*N* = 9			
Low Achieving Students						
Far Transfer	2.00	.82	1.33	.58	.91	*n.s.*
Maintenance	2.25	.50	.67	.58	2.96	15.04**
	N = 4		*N* = 3			
Normally Achieving Students						
Far Transfer	3.53	1.12	3.29	1.10	.21	*n.s.*
Maintenance	3.37	.96	2.88	1.11	.47	*n.s.*
	N =19		*N* = 17			

Note. *ES* = Effect size. All effect sizes in favor of the SM + visual display group.
*** = $p < .001$, ** = $p < .01$

Effects favored the SM + visual display group across each student type for far transfer posttest and maintenance. For far transfer posttest, there was a strong effect for students with LD and the low achieving group, although only the *ES* for students with LD was statistically significant. The normally achieving group had only a small effect for posttest. For far transfer maintenance, both students with LD and low achieving students had a strong, statistically significant effect. The normally achieving group had only a small maintenance effect. Of particular note, the low achieving group in the SM + visual display condition increased by .25 items correct between posttest and maintenance, while the SM only group decreased by .66 items correct. For both students with LD and normally achieving students in the SM + visual display condition, far transfer results were almost identical for posttest and maintenance.

Social Validity

Students were asked to answer three questions on a 5-point Likert scale (e.g., 1 = very little, 5 = very much). The results of the measure were separated by condition. For each question, mean by condition is displayed in Table 11.

Table 11. *Social Validity by Condition*

	SM +Visual Display	SM Only
Question	*M*	*M*
1. How much do feel you learned?	4.42	4.48
2. Did you like the semantic mapping lesson?	4.79	4.69
3. Did you like studying with the visual display (treatment) or semantic map (control)?	4.64	4.55
	N = 33	*N* = 29

Overall, students in both experimental conditions reported they felt they learned a lot and enjoyed the SM lesson as well as the opportunity to study with either the visual display or semantic map. There were no statistically significant differences between conditions on any of the three questions. After disaggregating the data, the students with LD, regardless of condition, supplied the highest ratings for each question. For example, for question 1, the means were 4.6 and 4.56 for the SM + visual display and SM only conditions, respectively. Question 2 yielded means of 4.9 and 4.89 and question 3 yielded means of 4.8 and 4.67, respectively.

Chapter 4

Discussion

The results of this study supported the conclusion that semantic mapping was beneficial for factual recall, while the additive effect of a visual display significantly improved maintenance and far transfer for adolescents with LD. Results of this study also supported the conclusion that normally achieving students and low achieving students also benefit from semantic mapping and the visual display. This finding was consistent over written and multiple-choice measures.

Written Factual Recall

The written factual recall measure tested the students' ability to produce newly acquired knowledge in essay form. Unfortunately, due to the school district request to use the five-paragraph outline worksheet, the measure ultimately tested only isolated facts the students' could remember and write in sentence form. Making matters worse, the time limitations (e.g., seven minutes) precluded any chance at depth or inferential/relational statements as students' had very little time to brainstorm and plan their writing effort. However, these issues aside, the data extracted from the written measures were consistent with the multiple-choice data, and yielded enough information for analysis.

Between pretest and posttest, the SM + visual display condition had a significantly larger mean gain increase in factual statements compared to the SM only condition (e.g., 4.03 compared to 3.09). An analysis of posttest only effects also favored the SM + visual display condition with a moderate significant effect ($ES = .78$, $p < .05$). After these data were disaggregated by student type, it was evident that students with LD had the largest mean gain increase between conditions (e.g., 4.00 compared to 2.67) and the only significant effect when comparing posttest only (*ES* = 1.59, $p < .01$), both favoring the SM + visual display condition. All other students (e.g., normally achieving and low achieving) made large gains from pretest to posttest on the written measures, but no significant differences were found between experimental conditions at posttest. This finding was somewhat surprising. Our hypothesis was that semantic mapping on its own would drive initial acquisition. Therefore, we did not expect such a strong and significant effect for the SM + visual display condition by students with LD at posttest. It is clear the additive effect of the visual display assisted students with LD beyond semantic mapping on its own for writing factual statements at posttest.

When the written factual recall measure was administered again for maintenance, 10 days after posttest, an overall significant strong effect (*ES* = 1.15, $p < .01$) was found favoring the SM + visual display condition. However, unlike posttest, there were large significant maintenance effects for both students with LD (*ES* = 1.46, $p < .05$) and normally achieving students (*ES* = 1.14, $p < .01$) after disaggregating by student type. Large effects were also found for low achieving students, but sample limitations (e.g., sample size = 7) negate their statistical significance. The maintenance results clearly match our hypothesis and support our previous finding that the additive effect of the visual display in addition to the semantic map helps students retain newly acquired factual knowledge (Dexter & Hughes, 2010).

The results of the written factual recall measure were consistent with the results of previous research examining GOs and recall of ideas and details in writing for students with LD (e.g., Sturm & Rankin-Erickson, 2002; Ruddell & Boyle, 1989; Draheim, 1983). Each of those studies also found students with LD were able to recall more factual details after attending to a GO. However, each of those studies took place in a resource room setting after regular school hours. The results presented in this study extend the literature on written factual recall by utilizing an inclusion classroom during the regular school day. In this natural setting, students with LD improved significantly, as did their normally achieving peers. Unfortunately, due to the brevity of this study, written measures accounting for relational or inferential statements, increased length, and improved holistic scores could not be administered. By limiting the results of the written measure to only factual recall, some important information often associated with GO research (e.g., attaining relational knowledge) was sacrificed (DiCecco & Gleason, 2002).

Multiple-Choice Factual Recall

Like the majority of studies on GOs with students with LD, this study measured factual recall with use of a multiple-choice test (Dexter & Hughes, 2010; Gajria et al., 2007; Kim et al., 2003). However, as the previous reviewed studies typically occurred in resource room or after school settings, this study utilized an inclusion classroom during regular school hours. This extends the previous research by testing effects in a more naturally occurring school environment with all types of students included.

As was hypothesized, even though there was a significant overall mean gain increase between pretest and posttest favoring the SM + visual display group (e.g., 7.61 compared to 6.21), there was no significant effect by condition at posttest only overall, or after disaggregation by student type. This supports our previous finding that semantic mapping by itself is effective for initial acquisition (Dexter & Hughes, 2010). Furthermore, the additive effect of the visual display was seen in the maintenance results ten days after posttest. Overall, the SM + visual display condition significantly outperformed the SM only condition at maintenance (*ES* = .78, $p < .01$). After disaggregating the results, large significant effects were found for students with LD (*ES* = 1.41, $p < .01$) and normally achieving students (*ES* = .84, $p < .05$). A large effect was also found for the low achieving group (*ES* = .89), but it did not reach statistical significance due to the small sample size (*N* = 7). Like posttest, this confirms our hypothesis and supports our previous finding that the additive effect of the visual display in addition to the semantic map is crucial for retention of newly acquired factual knowledge (Dexter & Hughes).

While these results matched our hypothesis and were promising, it is important to point out that even for the top overall student condition (SM + visual display) the mean multiple-choice posttest score was 14.85 out of 20. This equals 74.25% accuracy. While this would not be considered ideal by any teacher's standard, it is based on one class period of instruction on new material followed by a delayed (e.g., next day) posttest. This limitation should be addressed in future research.

Far Transfer

This study also measured students' far transfer ability (i.e., applying knowledge to situations not directly covered in the text or lecture) using a multiple-choice measure. Previous reviews of GO research with students with LD (e.g., Dexter & Hughes, 2010; Gajria et al., 2007; Kim et al., 2003) indicate that GOs may improve inference skills and relational knowledge for secondary students with LD. However, the evidence is limited due to the few studies explicitly measuring far transfer (Dexter & Hughes).

Across all students, there was an overall moderate far transfer effect favoring the SM + visual display group at posttest (*ES* = .53, $p < .05$). As was hypothesized, after disaggregation, a large significant effect was found for students with LD (*ES* = 1.70, $p < .01$), while only a small effect (*ES* = .21) was found for the normally achieving group. A large effect (*ES* = .91) was found for low achieving students, but again, did not reach statistical significance due to sample size. This finding is consistent with Mayer's (1979) contention that GOs assimilate material to a broader set of past experiences allowing students with lower verbal ability to more successfully transfer verbal information to new situations, while it may not be necessary for students with higher verbal ability (e.g., normally achieving students).

Likewise, at maintenance, students with LD demonstrated a significant large effect (*ES* = 1.84, $p < .001$) for the SM + visual display group, while the normally achieving group demonstrated only a moderate effect (*ES* = .47). Furthermore, the low achieving group, despite the small sample size, reached a statistically significant large effect at maintenance (*ES* = 2.96, $p < .01$). This supports our hypothesis and previous finding that the additive effect of a visual display to a semantic mapping lesson may bridge the connection of verbal information with prior knowledge and assist students with low verbal ability in far-transfer tasks over longer periods of time (Dexter & Hughes, 2010).

Social Validity

This study also measured student attitude toward the semantic mapping lesson, the GO they used to study before posttest, and how much they felt they learned. Across all students, the mean scores indicate students liked "very much" the semantic mapping lesson and the GO they used to study, regardless of type. All students also perceived they learned a lot from the lesson. In addition, the classroom teacher was impressed with the results and reported he will use this type of lesson and study format in the future.

Limitations and Directions for Future Research

While the results of this study are promising, there are two significant limitations to this research. First, the measures used in this study primarily focused on factual recall and far transfer. Focusing on these outcomes limited our ability to measure relational and inferential knowledge, which are important for GO research (DiCecco & Gleason, 2002). It is also important to note that all measures were created by a social studies expert and closely tied to the content. While the included measures should have good content validity, there is no way to measure broader construct validity. This fact may limit the generalizability of these findings and questions the actual level of understanding obtained by students across conditions (Boyle, 1996). Future research should find ways to include relational and inferential measures. Oral retell is a potential measure that could assess factual recall as well as more relational or inferential statements. Also, where possible, standardized measures could be used to measure broader construct validity.

The second significant limitation to this research was its brevity. There was only one day of instruction with the semantic mapping lesson that was new to all students. Previous research with GOs suggests a timeframe of four to six weeks for successfully implementing a GO intervention program (Gajria et al., 2007; DiCecco & Gleason, 2002). The positive effects for this study under such a short duration are promising. Future research should seek to test this kind of GO program over a longer period of time. Consistent use of these types of GOs over time will produce more far-reaching results and better inform inclusionary practice.

Implications for Practice

Consistent with the findings from the meta-analysis (see appendix B), this study found an instructionally intensive type of GO (e.g., semantic mapping) worked well for immediate factual recall across conditions, while the addition of a more computationally efficient GO (e.g., visual display) produced larger maintenance and transfer effects than semantic mapping alone. These results can help teachers in designing GOs for initial instruction and for re-teaching, studying, and retention purposes. As in this study, a semantic map for initial instruction, followed by a simpler visual display for review and study will potentially maximize the effects of recall, maintenance, and far-transfer for students with LD. The retention aspect has special relevance to secondary students with LD who must be able to retain knowledge learned in school for statewide testing and promotion/graduation purposes.

Additionally, this study found effects went beyond students with LD to low achieving students and normally achieving students. All students improved significantly between pretest and posttest on factual recall measures. All students, regardless of type, also demonstrated at least a small effect on posttest and maintenance only measures, as well as far transfer measures. There were no negative effects across any condition or any type of student. This finding lends support to the benefits of GOs for inclusive classrooms. Furthermore, this study found all students enjoyed using the GOs and felt they learned a great deal.

The evidence in this study should persuade educational practitioners to make well-planned and well-instructed use of graphic organizers. A thoughtful combination of types of graphic organizers will help make the learning process more efficient for all secondary students, especially those students with LD.

References

Adams, G., & Carnine, D. (2003). Direct instruction. In H.L. Swanson, K.R. Harris, & S. Graham (Eds.), *Handbook of Learning Disabilities* (pp. 403 – 416). New York: Guilford Press.

Amer, A.A. (1994). The effect of knowledge-map and underlining training on the reading comprehension of scientific texts. *English for Specific Purposes, 13,* 35 - 45.

Armbruster, B.B. (1984). The problems of "inconsiderate" text. In G.G. Duffy, L.R. Roehler, & J.M. Mason (Eds.), *Comprehension Instruction: Perspectives and suggestions* (pp. 202 – 217). New York: Longman.

Anders, P.L., Bos, C.S., & Filip, D. (1984). The effect of semantic feature analysis on the reading comprehension of learning disabled students. In J.A. Niles & L.A. Harris (Eds.), *Changing perspectives on reading/language processing and instruction* (pp. 162 – 166). Rochester, NY: National Reading Conference.

Atkinson, R.K., Levin, J.R., Kierwa, K.A., Meyers, T., Kim, S.I., Atkinson, L.A., Renandya, W.A., & Hwang, Y. (1999). Matrix and mnemonic text processing adjuncts: Comparing and combining their components. *Journal of Educational Psychology, 91*, 342 – 357.

Ausubel, D.P. (1960). The use of advanced organizers in learning and retention of meaningful material. *Journal of Educational Psychology, 51*, 267 – 272.

Ausubel, D.P. (1968). *Educational Psychology: A Cognitive View.* New York: Holt, Rinehart, & Winston.

Ausubel, D.P., & Fitzgerald, D. (1961). The role of discriminability in meaningful verbal learning and retention. *Journal of Educational Psychology, 52*, 266 – 274.

Ausubel, D.P., & Fitzgerald, D. (1962). Organizer, general background and antecedent learning variables in sequential verbal learning. *Journal of Educational Psychology, 53*, 243 – 249.

Ausubel, D.P., & Youssef, M. (1963). Role of discriminability in meaningful parallel learning. *Journal of Educational Psychology*, *54*, 331 – 336.

Baumann, J.F. (1984). The effectiveness of a direct instruction paradigm for teaching main idea comprehension. *Reading Research Quarterly, 20*, 93 – 115.

Bergerud, D., Lovitt, T.C., & Horton, S. (1988). The effectiveness of textbook adaptations in life science for high school students with learning disabilities. *Journal of Learning Disabilities*, *21*, 70 – 76.

Boon, R.T., Fore III, C., Ayres, K., Spencer, V.G. (2005). The effects of cognitive organizers to facilitate content-area learning for students with mild disabilities: A pilot study. *Journal of Instructional Psychology*, *32*, 101 – 117.

Bos, C.S., & Anders, P.L. (1990). Effects of interactive vocabulary instruction on the vocabulary learning and reading comprehension of junior-high learning disabled students. *Learning Disability Quarterly*, *13,* 31–42.

Bos, C.S., & Anders, P.L. (1992). Using interactive teaching and learning strategies to promote text comprehension and content learning for students with learning disabilities. *International Journal of Disability, Development, and Education, 39*, 225 – 238.

Bos, C.S., Anders, P.L., Filip, D., & Jaffe, L.E. (1989). The effects of an interactive instructional strategy for enhancing reading comprehension and content area learning for students with learning disabilities. *Journal of Learning Disabilities, 22,* 384–389.

Bos, C.S., & Vaughn, S. (2002). *Strategies for teaching students with learning and behavior problems* (5th ed.). Boston: Allyn & Bacon.

Boyle, J.R. (1996). The effects of a cognitive mapping strategy on the literal and inferential comprehension of students with mild disabilities. *Learning Disability Quarterly, 19,* 86–98.

Boyle, J.R. (2000). The effects of a Venn diagram strategy on the literal, inferential, and relational comprehension of students with mild disabilities. *Learning Disabilities: A Multidisciplinary Journal, 10,* 5–13.

Boyle, J.R., & Weishaar, M. (1997). The effects of expert-generated versus student-generated cognitive organizers on the reading comprehension of students with learning disabilities. *Learning Disabilities Research & Practice, 12*, 228 – 235.

Boyle, J.R., & Yeager, N. (1997). Blueprints for learning: Using cognitive frameworks for understanding. *Teaching Exceptional Children, 29,* 26 – 31.

Brigham, F.J., Scruggs, T.E., & Mastropieri, M.A. (1995). Elaborative maps for enhanced learning of historical information: Uniting spatial, verbal, and imaginable information. *The Journal of Special Education, 28,* 440 – 460.

Bryant, D.P., Ugel, N., Thompson, S., & Hamff, A. (1999). Instructional strategies for content-area reading instruction. *Intervention in School and Clinic, 34*, 293 – 302.

Burns, M. (1994). Empirical analysis of drill ratio research. *Remedial and Special Education, 25*, 167 – 173.

Clark, J.M., & Paivio, A. (1991). Dual coding theory and education. *Educational Psychology Review, 3*, 149 – 210.

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

Cox, R. (1999). Representation construction, externalized cognition, and individual differences. *Learning and Instruction, 9*, 343 – 363.

Darch, C., & Carnine, D. (1986). Teaching content area material to learning disabled students. *Exceptional Children, 53,* 240 – 246.

Darch, C.B., Carnine, D.W., & Kame'enui, E.J. (1986). The role of graphic organizers and social structure in content area instruction. *Journal of Reading Behavior, 18*, 275 – 295.

Darch, C., & Eaves, R. (1986). Visual displays to increase comprehension of high school learning-disabled students. *The Journal of Special Education, 20,* 309 - 318.

Darch, C., & Gersten, R. (1986). Direction-setting activities in reading comprehension: A comparison of two approaches. *Learning Disability Quarterly, 9*, 235–243.

Deshler, D.D., Ellis, E., & Lenz, B.K. (1996). *Teaching adolescents with learning disabilities: Strategies and methods.* Denver, CO: Love.

Dexter, D.D., & Hughes, C.A. (2010, April). *Graphic organizers and students with LD: How theory guides practice.* Paper presented at the International Council for Exceptional Children Conference, Nashville, TN.

DiCecco, V.M., & Gleason, M.M. (2002). Using graphic organizers to attain relational knowledge from expository text. *Journal of Learning Disabilities, 35,* 306–320.

Draheim, M.E. (1983). Facilitating comprehension and written recall of exposition through DRTA instruction and conceptual mapping. *Paper presented at the Annual Meeting of the National Reading Conference*. Austin, TX.

Englert, C.S., & Mariage, T.V. (1991). Making students partners in the comprehension process: Organizing the reading POSSE. *Learning Disability Quarterly, 14,* 123–138.

Fletcher, J.M., Lyon, G.R., Fuchs, L.S., & Barnes, M.A. (2007). *Learning disabilities: From identification to intervention.* New York: The Guilford Press.

Ford, D.Y. (1996). Determinants of underachievement as perceived by gifted, above average, and average black students. *Roeper Review, 14,* 130 – 136.

Gajria, M., Jitendra, A.K., Sood, S., Sacks, G. (2007). Improving comprehension of expository text in students with LD: A research synthesis. *Journal of Learning Disabilities*, *40*, 210 – 225.

Gardill, M.C., & Jitendra, A.K. (1999). Advanced story map instruction: Effects on the reading comprehension of students with learning disabilities. *The Journal of Special Education, 33*, 2 – 17.

Gersten, R., Baker, S., & Lloyd, J.W. (2000). Designing high-quality research in special education: Group experimental design. *The Journal of Special Education, 34*, 2 – 18.

Gersten, R., Fuchs, L.S., Compton, D., Coyne, M., Greenwood, C., Innocenti, M.S. (2005). Quality indicators for group experimental and quasi-experimental research in special education. *Exceptional Children, 71,* 149 – 164.

Gersten, R., Fuchs, L.S., Williams, J.P., & Baker, S. (2001). Teaching reading comprehension strategies to students with learning disabilities: A review of research. *Review of Educational Research, 71*, 279 – 320.

Griffin, C.C., Simmons, D.C., & Kame'enui, E.J. (1991). Investigating the effectiveness of graphic organizers instruction on the comprehension and recall of science content by students with learning disabilities. *Reading, Writing, and Learning Disabilities, 7,* 355–376.

Griffin, M.M., & Robinson, D.H. (2005). Does spatial or visual information in maps facilitate text recall? Reconsidering the conjoint retention hypothesis. *Educational Technology Research and Development, 53,* 23 – 36.

Hedges, L.V. (1981). Distribution theory for Glass's estimator of effect size and related estimators. *Journal of Educational Statistics, 6*, 107 – 128.

Hedges, L.V., Shymansky, J.A., & Woodworth, G. (1989). *A practical guide to modern methods of meta-analysis.* Washington, DC: National Science Teachers Association.

Holmes, B.C. (1985). The effects of a strategy and sequenced material on the inferential comprehension of disabled readers. *Journal of Learning Disabilities, 18*, 542 - 546.

Horton, P.B., McConney, A.A., Gallo, M., Woods, A.L., Senn, G.J., & Hamelin, D. (1993). An investigation of the effectiveness of concept mapping as an instructional tool. *Science Education, 77,* 95 – 111.

Horton, S.V., Lovitt, T.C., & Bergerud, D. (1990). The effectiveness of graphic organizers for three classifications of secondary students in content area classes. *Journal of Learning Disabilities, 23*, 12 – 22.

Hudson, P. (1996). Using a learning set to increase the test performance of students with learning disabilities in social studies classes. *Learning Disabilities Research & Practice, 11*, 78 – 85.

Hughes, C.A., & Archer, A. (in press). *Teaching students with learning difficulties: Effective and explicit instruction.* New York: Guilford Press.

Hughes, C.A., Maccini, P., & Gagnon, J.C. (2003). Interventions that positively impact the performance of students with learning disabilities in secondary general education classes. *Learning Disabilities, 12*, 101 – 111.

Hunter, J.E., & Schmidt, F.L. (2004). *Methods of meta-analysis: Correcting error and bias in research findings.* Thousand Oaks, CA: Sage Publications, Inc.

Idol, L., & Croll, V.J. (1987). Story-mapping training as a means of improving reading comprehension. *Learning Disability Quarterly, 10*, 214 – 229.

Ives, B. (2007). Graphic organizers applied to secondary algebra instruction for students with learning disorders. *Learning Disabilities Research & Practice, 22,* 110 – 118.

Ives, B., & Hoy, C. (2003). Graphic organizers applied to higher-level secondary mathematics. *Learning Disabilities Research & Practice, 18,* 36 – 51.

Johnson, L., Graham, S., & Harris, K.R. (1997). The effects of goal setting and self-instructions on learning a reading comprehension strategy: A study with students with learning disabilities. *Journal of Learning Disabilities, 30,* 80 – 91.

Kim, A., Vaughn, S., Wanzek, J., Wei, S. (2004). Graphic organizers and their effects on the reading comprehension of students with LD: A synthesis of research. *Journal of Learning Disabilities, 37,* 105 – 118.

Krumboltz, J.D. & Nichols, C. W. (1990) 'Integrating the social learning theory of career decision making', in Walsh, W.B. & Osipow, S.H. (Eds) Career Counseling: contemporary topics in vocational psychology, New Jersey, Lawrence Erlbaum Associates, pp.159-192.

Kulhavy, R.W., Lee, B.J., & Caterino, L.C. (1985). Conjoint retention of maps and related discourse. *Contemporary Educational Psychology, 10*, 28 - 37.

Kulhavy, R.W., Stock, W.A., & Caterino, L.C. (1994). Reference maps as a framework for remembering text. In Schnotz, W., & Kulhavy, R.W. (Eds.). *Comprehension of Graphics*, Elsevier Science, New York, pp. 153 – 162.

Kulhavy, R.W., Stock, W.A., & Kealy, W.A. (1993a). How geographic maps increase recall of instructional text. *Educational Technology Research and Development, 41*, 47 – 62.

Kulhavy, R.W., Stock, W.A., Peterson, S.E., Pridemore, D.R., & Klein, J.D. (1992). Using maps to retrieve text: A test of conjoint retention. *Contemporary Educational Psychology, 17*, 56 – 70.

Kulhavy, R.W., Woodard, K.A., Haygood, R.C., & Webb, J.M. (1993c). Using maps to remember text: An instructional analysis. *British Journal of Educational Psychology, 63*, 161 – 169.

Larkin, J.H., & Simon, H.A. (1987). Why a diagram is (sometimes) worth ten thousand words. *Cognitive Science*, *11*, 65 – 99.

Lipsey, M.W., & Wilson, D.B. (1993). The efficacy of psychological, educational, and behavioral treatment. *The American Psychologist*, *48*, 1181 – 1201.

Lipsey, M.W., & Wilson, D.B. (2001). *Practical meta-analysis* (Vol. 49). Thousand

Oaks, CA: Sage Publications, Inc.

Lovitt, T., Rudsit, J., Jenkins, J., Pious, C., & Benedetti, D. (1986). Adapting science materials for regular and learning disabled seventh graders. *Remedial and Special Education, 7,* 31 – 39.

Mastropieri, M.A., Scruggs, T.E., & Levin, J.R. (1987). Learning-disabled students' memory for expository prose: Mnemonic versus nonmnemonic pictures. *American Educational Research Journal, 24,* 505 – 519.

Mayer, R.E. (1975a). Information processing variables in learning to solve problems. *Review of Educational Research, 45,* 525 – 541.

Mayer, R.E. (1975b). Different problem solving competencies established in computer programming with and without meaningful models. *Journal of Educational Psychology, 67,* 725 – 734.

Mayer, R.E. (1977a). Different rule systems for counting behavior acquired in meaningful and rote contexts of learning. *Journal of Educational Psychology, 69,* 537 – 546.

Mayer, R.E. (1977). The sequencing of instruction and the concept of assimilation-to-schema. *Instructional Science, 6,* 369 – 388.

Mayer, R.E. (1979). Can advanced organizers influence meaningful learning? *Review of Educational Research, 49,* 371 – 383.

Mayer, R.E. (1989a). Models for understanding. *Review of Educational Research, 59,* 43 – 64.

Mayer, R.E. (1989b). Systematic thinking fostered by illustrations in scientific text. *Journal of Educational Psychology, 81,* 240 – 246.

Mayer, R.E., & Anderson, R.B. (1991). Animations need narrations: An experimental test of a dual coding hypothesis. *Journal of Educational Psychology, 83*, 484 – 490.

Mayer, R.E., & Anderson, R.B. (1992). The instructive animation: Helping students build connections between words and pictures in multimedia learning. *Journal of Educational Psychology, 84*, 444 – 452.

Mayer, R.E., Bove, W., Bryman, A., Mars, R., & Tapanengco, L. (1996). When less is more: Meaningful learning from visual and verbal summaries of science textbook lessons. *Journal of Educational Psychology, 88*, 64 – 73.

Mayer, R.E., & Gallini, J.K. (1990). When is an illustration worth ten thousand words? *Journal of Educational Psychology, 82*, 715 – 726.

Mayer, R.E., & Moreno, R. (1998). A split-attention effect in multimedia learning: Evidence for dual processing systems in working memory. *Journal of Educational Psychology, 90*, 312 – 320.

Mayer, R.E., & Sims, V.K. (1994). For whom is a picture worth a thousand words? Extensions of a dual coding theory of multimedia learning. *Journal of Educational Psychology, 86*, 389 – 401.

Mayer, R.E., Steinhoff, K., Bower, G., & Mars, R. (1995). A generative theory of textbook design: Using annotated illustrations to foster meaningful learning of science text. *Educational Technology Research and Development, 43*, 31 – 43.

Mayer, R.E., Stiehl, C.C., & Greeno, J.G. (1975). Acquisition of understanding and skill in relation to subjects' preparation and meaningfulness of instruction. *Journal of Educational Psychology, 67*, 331 – 350.

McCoach, D.B., & Siegle, D. (2001). A comparison of high achievers' and low achievers' attitudes, perceptions, and motivations. *Academic Exchange, 2*, 71 – 76.

McCrudden, M.T., Schraw, G., Lehman, S., & Poliquin, A. (2007). The effect of causal diagrams on text learning. *Contemporary Educational Psychology, 32*, 367 – 388.

Merrill, M.D., & Stolurow, L.M. (1966). Hierarchical preview vs. problem oriented review in learning an imaginary science. *American Educational Research Journal, 3*, 251 – 261.

Minskoff, E., & Allsopp, D. (2003). *Academic success strategies for adolescents with learning disabilities and ADHD.* Baltimore, MD: Brookes Publishing.

Moore, D.W., & Readence, J.F. (1984). A quantitative and qualitative review of graphic organizer research. *Journal of Educational Research, 78*, 11 – 17.

Moreno, R., & Mayer, R.E. (1999). Cognitive principles of multimedia learning: The role of modality and contiguity. *Journal of Educational Psychology, 91*, 358 – 368.

Moyer, J.C., Sowder, L., Threadgill-Sowder, J., & Moyer, M.B. (1984). Story problem formats: Drawn versus verbal versus telegraphic. *Journal for Research in Mathematics Education, 15*, 342 – 351.

Nesbit, J.C., & Adesope, O.O. (2006). Learning with concept and knowledge maps: A meta-analysis. *Review of Educational Research, 76*, 413 – 448.

O'Donnell, A.M., Dansereau, D.F., & Hall, R.H. (2002). Knowledge maps as scaffolds for cognitive processing. *Educational Psychology Review, 14*, 71 – 86.

Orwin, R.G. (1983). A fail-safe *N* for effect size in meta-analysis. *Journal of Educational Statistics*, *8*, 157 – 159.

Paivio, A. (1966). Latency of verbal associations and imagery to noun stimuli as a function of abstractness and generality. *Canadian Journal of Psychology, 20,* 378 – 387.

Paivio, A. (1975a). Neomentalism. *Canadian Journal of Psychology*, *29*, 263 – 291.

Paivio, A. (1971). *Imagery and verbal processes.* New York: Holt, Rinehart, & Winston.

Paivio, A. (1983). The mind's eye in arts and science. *Poetics*, *12*, 1 – 18.

Paivio, A. (1986). *Mental representations: A dual coding approach.* New York: Oxford University Press.

Paivio, A. (1991). *Images in mind: The evolution of a theory.* Sussex, England: Harvester.

Paivio, A. (2007). *Mind and its evolution: A dual coding theoretical approach.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Paivio, A., Yuille, J.C., & Madigan, S.A. (1968). Concreteness, imagery, and meaningfulness values for 925 nouns. *Journal of Experimental Psychology Monograph Supplement, 76* (1, Pt. 2), 1 – 25.

Passolunghi, M.C., & Siegel, L.S. (2004). Working memory and access to numerical information in children with disability in mathematics. *Journal of Experimental Child Psychology*, *88*, 348 – 367.

Patterson, M.E., Dansereau, D.F., & Wiegmann, D.A. (1993). Receiving information during a cooperative episode: Effects of communication aids and verbal ability. *Learning and Individual Differences*, *5*, 1 -11.

Pressley, M. & Harris, K.R. (1994). More about increasing the quality of educational intervention research: A synthesis. *Educational Psychology Review, 6,* 271 – 289.

Reyes, E.I., Gallego, M.A., Duran, G.Z., & Scanlon, D.J. (1989). Integration of internal concepts and external factors: Extending the knowledge of learning disabled adolescents. *The Journal of Early Adolescence, 9,* 112 – 124.

Rice, G.E. (1994). Need for explanations in graphic organizer research. *Reading Psychology: An International Quarterly, 15*, 39 – 67.

Rivera, D.P., & Smith, D. (1997). *Teaching students with learning and behavior problems* (3rd Ed.). Boston: Allyn & Bacon.

Robinson, D.H., Katayama, A.D., DuBois, N.F., & Devaney, T. (1998). Interactive effects of graphic organizers and delayed review on concept acquisition. *Journal of Experimental Education, 67,* 17 -31.

Robinson, D.H., & Kierwa, K.A. (1995). Visual argument: Graphic organizers are superior to outlines in improving learning from text. *Journal of Educational Psychology, 87,* 455 – 476.

Robinson, D.H., & Schraw, G. (1994). Computational efficiency through visual argument: Do graphic organizers communicate relations in text too effectively? *Contemporary Educational Psychology*, *19*, 399 – 415.

Robinson, D.H., & Skinner, C.H. (1996). Why graphic organizers facilitate search processes: Fewer words or computationally efficient indexing? *Contemporary Educational Psychology, 21,* 166 – 180.

Rosenthal, R. (1979). The “file-drawer” problem and tolerance for null results. *Psychological Bulletin, 86,* 638 – 641.

Rosenthal, R. (1994). Statistically describing and combining studies. In H. Cooper & L.V. Hedges (Eds.), *The handbook of research synthesis* (pp. 231 – 244). New York: Russell Sage Foundation.

Ruddell, R.B., & Boyle, O.F. (1989). A study of cognitive mapping as a means to improve summarization and comprehension of expository text. *Reading Research and Instruction, 29*, 12 – 22.

Sadoski, M., & Paivio, A. (2001). *Imagery and text: A dual coding theory of reading and writing.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Schunk, D.H. (1998, November). *Motivation and self-regulation among gifted learners.* Paper presented at the annual meeting of the National Association of Gifted Children, Louisville, KY.

Sinatra, R.C., Stahl-Gemake, J., & Berg, D.N. (1984). Improving reading comprehension of disabled readers through mapping. *The Reading Teacher, 38*, 22 – 29.

Slavin, R.E. (1995). Best evidence synthesis: An intelligent alternative to meta-analysis. *Journal of Clinical Epidemiology, 48,* 9 – 18.

Smith, M.L. (1980). Publication bias and meta-analysis. *Evaluation in Education, 4*, 22 - 24.

Stensvold, M.S., & Wilson, J.T. (1990). The interaction of verbal ability with concept mapping in learning from a chemistry laboratory activity. *Science Education, 74*, 473 – 480.

Sturm, J.M., & Rankin-Erickson, J.L. (2002). Effects of hand-drawn and computer-generated concept mapping on the expository writing of middle school students with learning disabilities. *Learning Disabilities Research & Practice, 17*, 124 –

139.

Suritsky, S.K., & Hughes, C.A. (1991). Benefits of notetaking: Implications for secondary and postsecondary students with learning disabilities. *Learning Disability Quarterly, 14*, 7 – 18.

Swanson, H.L., Hoskyn, M., & Lee, C. (1999). *Interventions for students with learning disabilities.* New York: Guilford Press.

Swanson, L., & Kim, K. (2007). Working memory, short-term memory, and naming speed as predictors of children's mathematical performance. *Intelligence*, *35*, 151 – 168.

Thalheimer, W., & Cook, S. (2002, August). *How to calculate effect sizes from published research articles: A simplified methodology.* Retrieved October 1, 2009 from http://work-learning.com/effect_sizes.htm.

Thompson, W.L., & Kosslyn, S.M. (2000). Neural systems activated during visual mental imagery. In A.W. Toga, & J.C. Mazziotta (Eds.), *Brain Mapping: The Systems* (pp. 535 – 560). San Diego, CA: Academic Press.

Vekiri, I. (2002). What is the value of graphical displays in learning? *Educational Psychology Review, 14*, 261 – 313.

Waller, R. (1981, April). *Understanding network diagrams.* Paper presented at the annual meeting of the American Educational Research Association, Los Angeles.

Washington, V.M. (1988). Semantic Mapping: A heuristic for helping learning disabled students write reports. *Reading, Writing, and Learning Disabilities, 4*, 17 – 25.

Wechsler, D. (1991). *Wechsler Intelligence Scale for Children* (3rd ed.). San Antonio, TX: Psychological Corporation.

Wiegmann, D.A., Dansereau, D.F., McCagg, E.C., Rewey, K.L., & Pitre, U. (1992). Effects of knowledge map characteristics on information processing. *Contemporary Educational Psychology*, *17*, 136 – 155.

Williams, J.P. (1993). Comprehension of students with or without learning disabilities: Identification of narrative themes and idiosyncratic text representations. *Journal of Educational Psychology*, *85*, 631 – 641.

Winn, W. (1991). Learning from maps and diagrams. *Educational Psychology Review*, *3*, 211 – 247.

Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson III Tests of Cognitive Abilities*. Itasca, IL: Riverside Publishing.

Appendix A

Review of Relevant Theory

Students with LD need explicit content enhancements to assist in verbal (e.g., text or lecture) comprehension and graphic organizers (GOs) have often been recommended as an instructional device to assist these students in understanding increasingly abstract concepts (Kim et al., 2004; Ives & Hoy, 2003; Bos & Vaughn, 2002; Hughes et al., 2003; Nesbit & Adesope, 2007; Rivera & Smith, 1997). Because of the suggested value of GOs in helping to facilitate verbal information and concept relationships, a number of questions related to the underlying theories of GOs are of particular interest to intermediate and secondary personnel responsible for providing GOs for students with LD. Understanding why and when GOs can contribute to learning will help researchers and educators develop research-based principles for GO design and instructional use (Vekiri, 2002).

According to Krumboltz and Nichols (1990), theory-based research should help understanding of complex phenomenon, make predictions about future outcomes, and decide courses of action for future research. However, in the special education literature on GOs, little attention has been paid to the underlying theories explaining why GOs work (Dexter & Hughes, 2010). This omission of theory in creating experiments involving GOs and students with LD has led to a largely disjointed literature base (Gajria et al., 2007; Kim et al., 2003), lacking the level of quality called for in the field (Gersten et al., 2005; Pressley & Harris, 1994). Therefore, the purpose of this article is to look back to the past and summarize research on the underlying theories of GOs, as to better shape the future of research with GOs and students with LD. Focusing on this group's learning characteristics, recommendations for GO design and delivery as well as critical areas for future research will be provided.

Specifically, from a cognitive psychology perspective, what are the potential benefits of using GOs? What specific design elements of GOs may facilitate comprehension of expository text based on the cognitive characteristics of students with LD? Finally, what specific recommendations can be gleaned from the cognitive psychology research base to guide special education researchers and practitioners? Answers to these questions are critical in designing and utilizing GOs in a purposeful and efficient manner for students with LD.

Theoretical Perspectives on Benefits of Graphic Organizers

Two major theories about GOs exist in the cognitive psychology literature; the theory of subsumption (Ausubel, 1960) and assimilation theory (Mayer, 1979). Both theories offer direct implications about the possible benefits of GOs in learning. These two theories provide the basis for how GOs are able to help facilitate understanding of unfamiliar material and clarify relationships between abstract concepts. Both theories will be presented, along with a brief overview of relevant research findings.

Theory of Subsumption

GOs, as they are recognized today, are descended from Ausubel's (1960) theory of subsumption (Vekiri, 2002). Subsumption is a process in which new material is related to relevant ideas in the existing cognitive structure. The theory contains two fundamental principles: 1) The most general ideas of a subject should be presented first and then progressively differentiated in terms of detail and specificity; and 2) Instructional materials should attempt to integrate new material with previously presented information through comparisons and cross-referencing of new and old ideas (Ausubel, 1968). To aid in subsumption, Ausubel advocated the use of GOs in the classroom. According to the theory, a GO presented in advance of a lesson may help incorporate and facilitate longevity of newly learned material within the cognitive structure. The GO cues up relevant prior knowledge, provides a framework for the addition of new material, and in doing so makes new information easier to understand and remember. It is important to note that Ausubel (1960) emphasized that GOs presented in advance of a lesson are different from overviews and summaries, which simply emphasize key ideas and are presented at the same level of abstraction and generality as the rest of the material. Advance GOs act as a subsuming bridge between new learning material and existing related ideas (Ausubel). An example of this kind of GO is shown in Fig. 1. Here, the reader links new material (e.g., Hinduism) with previously learned material (e.g., Buddhism). In this example, very general ideas of the two religions (e.g., country of origin, deities, etc.) are compared and other broad similarities (e.g., belief in reincarnation, etc.) between the new and old concepts are stated. According to the theory of subsumption, this type of GO would provide a better framework for learning about Hinduism than would a non-organizing historical introduction to the religion (Mayer, 1979).

Figure 1. *Example of Subsumption*

	Previously learned:	***New Material:***
	Buddhism	**Hinduism**
Country of Origin:	India	India
Deity(ies):	None	Brahma, Vishnu, and Shiva
Founder(s):	Siddhartha Guatama, who later became Buddha	Unknown
Sacred Books:	None, verbal tradition	Upanishads, Vedaas, Puranas
Leadership:	Buddhist monks and nuns	Guru, Holy Man, Brahman Priests
Main Belief(s):	Nirvana is reached by following the Eight Fold Path and Four Noble Truths	Freedom from earthly desires comes from a lifetime of worship, knowledge, and virtuous acts

Similarities

-Belief in reincarnation, or the rebirth of the soul
-Happiness is achieved by eliminating all attachments to world and earthly things
-Provide explanation for the meaning of life and how to reach happiness for all eternity

Research Evidence

A series of research studies were published in the 1960's that provided the empirical support for the theory of subsumption as it relates to the effects of GOs on learning from text (Ausubel, 1960; Ausubel & Fitzgerald, 1961, 1962; Ausubel & Youssef, 1963; Merrill & Stolurow, 1966; Newton & Hickey, 1965). Each study demonstrated positive effects for a GO condition vs. a control condition on retention of expository text. For example, in a typical study (Ausubel & Youssef, 1963), college students read a 2500-word passage on Buddhism after examining either a GO relating Buddhism to Christianity (e.g., similar to Fig. 1) or reading an introductory expository passage on Buddhism. The GO condition demonstrated significantly higher retention for the target passage as measured by an unspecified achievement test. Ausubel & Youssef attributed the findings to the “learners’ linkage of new concepts (Buddhism) to prior knowledge about Christianity” (p. 371; Mayer, 1979).

Although positive results are demonstrated in each of the Ausubel studies, Mayer (1977) noted the studies “generally only found small advantages in recall due to advance organizers” (p. 374). However, through differential analysis, Ausubel (1968) found the largest facilitating effect of advance organizers on learners who had relatively poor verbal ability. Learners with average or above-average verbal ability demonstrated less of an effect. Further, Ausubel found learners with little or no prior knowledge on the topic benefitted more from the GOs than students with more background knowledge.

Assimilation Theory

Mayer (1979) built his assimilation theory off of similar principles to the theory of subsumption. According to the assimilation theory, new information is added to the cognitive structure via (a) reception (e.g., new information is received into working memory), (b) availability (e.g., anchoring knowledge is available in long-term memory), and (c) activation (e.g., anchoring knowledge is transferred from long-term memory to working memory so that it can be actively integrated with received information). For example, when a student in Geography class is learning the customs of another country, she must first process the new material through lecture or text (reception), think of similar customs in her own country (availability), and compare/contrast the new customs with those of which she is familiar (activation). Mayer surmises there are at least three sources of why GOs succeed or fail in influencing availability and activation: the material, the GO itself, and the learner. First, the material must contain a systematic overall structure. For example, if new material were a collection of isolated facts (e.g., Greek alphabet) a GO would fail because there is no inherent relationship (e.g., hierarchical, comparative, sequential, etc.) in the material. Second, the GO must provide an assimilative context to be useful. There should be a direct and explicit linkage between the content and the GO. For example, a teacher may use a GO illustrating the steps in an assembly line for making a shirt as an introduction to an industrial revolution unit. However, if learners do not realize the GO is related to the subsequent lesson, it is of no use. Finally, if the learner himself already possesses a plethora of past experience and knowledge, GOs are of little or no use. Mayer, echoing Ausubel, states, "professionals and high-ability learners may not need organizers while novices and low ability learners do" (p. 376).

Research Evidence

Mayer and colleagues conducted a series of studies that provided the basis for the assimilation theory (Mayer, 1975a, 1975b; Mayer, 1976; Mayer 1977a; Mayer 1977; Mayer, Stiehl, & Greeno, 1975). Each study compared a GO group with a control group on posttests including far-transfer (e.g., applying knowledge to situations not covered in the text) and near-transfer (e.g., applying knowledge to situations directly covered in the text) items. In each study, participants in the GO group significantly outperformed the control group in far-transfer items, while the control group slightly outperformed the GO group in near-transfer items. In a typical study, Mayer (1975b), 176 college freshmen with no prior computer programming experience read a 10-page booklet concerning computer-programming language. The GO group received a booklet that began with a graphical model of the computer and explained each program statement in the context of the model, while the control group read the same program statements without the graphical model. On a subsequent posttest, the GO group excelled on items that required thinking beyond what was presented in the booklet (far-transfer) and the control group performed slightly better on items that were similar to the exact statements in the booklet (near-transfer).

Mayer (1979) suggests, based on the series of studies, the GO group consistently assimilated the material to a broader set of past experiences allowing superior transfer to new situations, but this assimilation may not have allowed memorization of exact statements in the working memory. Because the control group only had the booklet, the researchers attribute the group's success on near-transfer items to memorization of exact statements. Another key finding from this series of studies reflected a similar finding from Ausubel's research; students with high verbal and math ability (based on SAT scores) did not improve as much as students with low verbal and math ability when presented a GO (Mayer, 1975b).

Discussion and Implications for Students with LD

The research findings of both the theory of subsumption and assimilation theory appear to have specific implications for students with LD, although neither theory focused on this group of students. Specifically, students with LD may benefit more from GOs than their non-disabled peers. A consistent pattern that emerged from the research on these theories is that students displaying lower verbal ability demonstrated larger gains than did students with average or high verbal ability, and these gains helped the students with lower verbal ability match the scores of peers with average verbal ability. As addressed earlier, students with LD typically have low verbal ability (Kim et al., 2004) that often manifests itself as difficulty in connecting new material to prior knowledge

(Williams, 1993). This is because, according to Mayer (1979), the specific structure of a GO may guide construction of cognitive structures in less knowledgeable students, but may conflict with pre-existing cognitive structures in more knowledgeable students. Several research groups have replicated the finding that low-ability learners gain more knowledge than average or high-ability learners from GOs (Moyer, Sowder, Threadgill-Sowder, & Moyer, 1984; Stensvold & Wilson, 1990; Patterson, Dansereau, & Wiegmann, 1993). O'Donnell, Dansereau, and Hall (2002) posit that low-ability learners gain their benefits because they can more easily understand and construct GOs than they can understand and write expository text. GOs may also offer a relatively consistent and simple syntax, making them easier to comprehend than textbooks or lecture (Amer, 1994). These ideas are all consistent with recommended content enhancements for students with LD (Deshler et al., 1996).

Students with LD also typically perform poorly on far-transfer tasks (e.g., applying knowledge to new or unusual situations) due to their inability to detect underlying concepts in verbal information (Suritsky & Hughes, 1991). Based on the above theories, this may be due to difficulty assimilating verbal information with previous knowledge. The research evidence of the assimilation theory suggests GOs may be the bridge in connecting verbal information with prior knowledge. This may dramatically assist students with LD in far-transfer tasks.

There is also some evidence that GOs may reduce the cognitive load handled in the working memory (Passolunghi & Siegel, 2004). Because GOs are a permanent product and present information in an abbreviated form compared to text or lecture, important concepts are more easily assimilated with prior knowledge in long-term memory (Hughes et al., 2003). This could help explain Mayer's (1979) findings in regard to far-transfer and near-transfer items. Students in the treatment group may have more fully realized the underlying concepts while the control group may have relied on rote memorization.

There appears to be a link between the underlying theories of GOs and students with LD. In fact, students with LD may benefit more than the average student from GOs. What these theories do not suggest is how to design GOs for maximum impact with these students. This is the theoretical base explored next.

Theoretical Perspectives on Graphic Organizer Design

The three most frequently cited theories in the cognitive psychology literature – visual argument hypothesis (Waller, 1981), dual coding theory (Paivio, 1971), and conjoint retention hypothesis (Kulhavy, Lee, & Caterino, 1985) – offer insight into the most effective and efficient design of GOs by forming the theoretical perspectives that explain the role of graphics in learning. Each of the three theories describes how learners process information, and there is overlap between the theories (Vekiri, 2002). Table 1 provides an overview of the three theories.

Table 1. *Comparison of VAH, DCT, & CRH.*

Theory	**Assumptions**	**Design Principles**
Visual Argument	1. Relationships among objects/concepts are apparent by their location in two-dimensional space.	- Static, two-dimensional representations spatially encoded - Can be used before, during, or after lesson - Minimizes cognitive processing and allows viewers to perceive relations or data patterns using visual perception.
Dual Coding	1. Two separate, but	- GOs should address goal

	interconnected, cognitive subsystems for verbal and visual information. 2. Verbal and visual information presented at the same time bolsters encoding.	of task and make target information apparent - GOs not effective without guiding explanations - GOs should be spatially and timely coordinated to minimize cognitive load - Explanations more effective when provided in auditory fashion
Conjoint Retention	1. Two separate, but interconnected, cognitive subsystems for verbal and visual information. 2. Maps, specifically, are encoded as intact units and their mental images maintain information on their visuospatial properties (Vekiri, 2002)	- GOs like concept or geographical maps that are used as adjunct displays for factual learning are more effective when presented before the text (or lecture)

The main idea of each of the theories is that the presentation of graphics (e.g., GOs) has an additive effect on learning because, according to Vekiri, "visual information is represented separately from verbal information in long-term memory" (p. 262). Each theory will be presented along with a brief overview of relevant research findings.

Visual Argument Hypothesis

Visual argument was first theorized by Waller (1981) to help explain the process by which graphics convey information. According to Vekiri (2002), the visual argument hypothesis is based on the idea that the visuospatial properties of graphics require fewer cognitive transformations (e.g., untangling implicit information to make it explicit) than does text-processing resulting in less stress on working memory. Further, not only individual elements of GOs, but also the spatial arrangement of the individual elements can help facilitate information. Larkin and Simon (1987) termed this effect *perceptual* *enhancement*, the ability of graphics to convey an overarching concept as well as demonstrate relationships between individual concepts. Thus, graphics could promote a cognitively easier way to perceive and make inferences about relationships among concepts than text (Vekiri; Robinson & Kierwa, 1995; Winn, 1991).

GOs developed using visual argument components use the “relative location of objects in two-dimensional space to communicate relations among those objects” (Robinson & Schraw, 1994; p. 401). For example, a tree diagram communicates hierarchical relationships by grouping smaller, related concepts under a larger, broad concept. This type of GO streamlines the process of inferring relationships between concepts. Without the tree diagram, a student would have to search through text to find a fact, retain that fact in working memory, and search for subsequent facts within the text before making an inference (Robinson & Schraw). Thus, through visual argument, students can make important inferences with much less cognitive effort (Winn, 1991; Vekiri, 2002). This apparent efficiency is echoed in the work of Larkin and Simon (1987), who concluded GOs developed using visual argument are superior to verbal descriptions in two important ways: (1) decreases search time for elements needed in making an inference; and (2) spatial arrangement of single elements eliminates the need to match symbolic labels (p. 98). For example, by viewing the GO in Fig. 2, one can learn that Old English Sheepdogs, German Shepherds, and Australian Cattle Dogs are all in the Herding Group. This hierarchical concept relation is communicated by locating the names of the three subordinate concepts below the name of the superordinate concept (Herding Group). One may also learn by viewing Fig. 2 that the German Shepherd is the heaviest of the three dogs. This coordinated concept relation is communicated by locating the comparative attributes (e.g., weight) in a single row. The GOs spatial arrangement may help students locate coordinating concepts more quickly (Robinson & Skinner, 1996) and with less effort (Robinson & Schraw, 1994) than if viewed linearly in text or in an outline.

Figure 2. *Visual Argument*

Herding Group

	Old English Sheepdog	*German Shepherd*	*Australian Cattle Dog*
Weight	65 lbs.	77-85 lbs.	32-35 lbs.
Height	22-24 inches	22-26 inches	17-20 inches
Temperament	Intelligent, friendly, docile	Confident, direct, approachable	Loyal, alert, courageous
Country of Origin	England	Germany	Australia

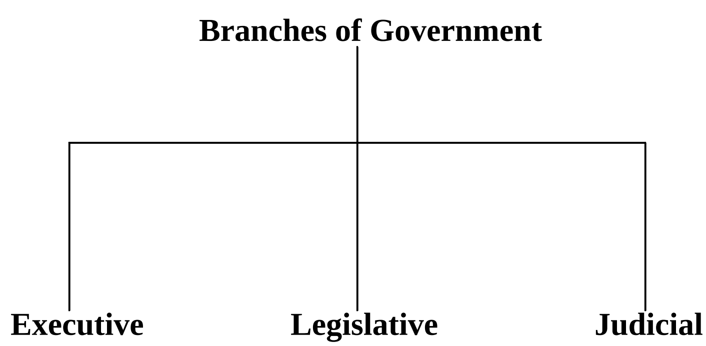
In summary, GOs designed using visual argument attributes can be processed in a more efficient manner than text. This supports better cognition in complex tasks (Vekiri, 2002). Not only can GOs demonstrate relationships between concepts without overloading the working memory, they can serve as memory aids, guide thinking, and help facilitate better problem solving techniques (Larkin & Simon, 1987).

Research Evidence for Visual Argument

A number of research studies have focused on the visual argument hypothesis, with the majority utilizing college and graduate students as participants. Evidence from these studies suggest it is the quality of information the GOs communicate that leads to their advantage over expository text or other nongraphic displays in making inferences about relationships of concepts (Vekiri, 2002). A series of studies, conducted by

Robinson and colleagues (Robinson, Katayama, Dubois, & Devaney, 1998; Robinson & Skinner, 1996; Robinson & Kiewra, 1995; Robinson & Schraw, 1994), comparing GOs (e.g., tree diagrams, matrices, network charts) with traditional, nongraphic outlines illustrate the point. (Fig. 3 illustrates the difference between a GO and nongraphic outline). In each of the studies, groups using GOs and traditional outlines equally outperformed text-only groups in factual recall, but the GO groups significantly outperformed the outline and text-only groups in identifying concept relations and making concept comparisons. A more recent study, McCrudden, Schraw, Lehman, and Poliquin (2007) is consistent with these results. In two experiments, students studied science material with a GO (e.g., causal diagram) or text alone. In both experiments, factual knowledge was equal, but the GO group performed better in understanding five causal sequences. Each of these studies support the visual argument hypothesis in that GOs conveyed factual information as well as text alone or nongraphic outlines and produced better conceptual understanding of relationships than text or outlines.

Figure 3*. Difference between a GO and non-graphical outline*



Lead by:	President	Congress	Supreme Court
Primary Job:	Enforce laws	Make laws	Interpret Laws

Branches of Government

I. Executive
 A. Lead By: President
 B. Primary Job: Enforce Laws

II. Legislative
 A. Lead By: Congress
 B. Primary Job: Make Laws

III. Judicial
 A. Lead By: Supreme Court
 B. Primary Job: Interpret Laws

Research evidence also supports careful planning in the design of GOs to optimize benefits from visual argument. For instance, Wiegmann, Dansereau, McCagg, Rewey, and Pitre (1992) compared structural design elements of GOs (e.g., knowledge maps). The researchers compared random web-configured GOs vs. GOs using Gestalt principles (e.g., proximity of related facts, concept clusters), and knowledge maps with simple lines vs. maps with links explaining relationships. GOs using Gestalt principles were more effective than web-configured and maps with embellished links were better for high-verbal students while simple lines were more effective for low-verbal students. The researchers also suggested that large, complex GOs might hinder performance in low-verbal students. The proximity issue is echoed in the research of Atkinson et al. (1999) who found GOs were only effective for concept learning and application when important information was grouped together spatially. If students could not see relationships between concepts easily on the GO, it provided very little advantage over nongraphic outlines or text.

In summary, research evidence supports the visual argument hypothesis when GOs are structured in a way that easily facilitates understanding and perception of concept relationships. If there is an overabundance of information or concept relationships are not clear, GOs may provide little or no assistance to learners.

Dual Coding Theory

The dual coding theory (DCT), developed by Allan Paivio in 1971 and subsequently updated (e.g., Paivio, 1986, 1991, 2007; Sadoski & Paivio, 2001), is based on the assumption that cognition "involves the activity of two distinct cognitive subsystems, a verbal system specialized for dealing directly with language and a nonverbal system specialized for dealing with nonlinguistic objects and events" (Paivio, 2007; p. 13). Although these systems are both functionally and structurally independent, they are interconnected in the tasks of processing and storing information. For example, a person can associate the word "coat" with a picture of a coat, and when hearing the word coat, elicit a mental image of a coat. Thus, associative connections are formed between verbal and visual representations (Vekiri, 2002). Based on this theory, GOs can greatly benefit encoding of new information by presenting visual and verbal information concurrently.

Clark and Paivio (1991) offer two direct implications of DCT on educational outcomes. Specifically, the role concreteness, imagery, and verbal associative processes play for comprehension of knowledge and learning and memory of school material. First, the researchers claim illustrations and other visual stimuli may improve recall of verbal information (e.g., lecture or text) by "enabling students to store the same material in two forms of memory representations, linguistic and visual" (Vekiri, 2002; p. 267).

According to Clark and Paivio, when verbal and visual information is presented at the same time, learners form associations between both types of material during encoding. Thus, learners may have more paths to retrieve information because subsequent verbal information may activate both linguistic and visual representations. In an applied setting, this means illustrations in text and lectures may foster greater retention because learners have two ways to memorize material (Vekiri).

Second, the researchers claim learners are more likely to recall concrete over abstract information (Clark & Paivio; Paivio, 2007; Paivio, 1991). In several research studies (e.g., Paivio, Yuille, & Madigan, 1968; Paivio, 1966, 1975a), Paivio and colleagues found concrete words more easily evoked a mental image than abstract words. Further, the researchers found a strong, positive correlation between mental imagery and text comprehension. According to Paivio (2007), recent work in neuroscience and brain imagery (e.g., Thompson & Kosslyn, 2000) supports DCT in that different sections of the brain are utilized during verbal encoding and visual encoding. From an applied standpoint, use of visual displays may increase the concreteness of instruction when material is abstract; and, providing a multitude of visual stimuli may bolster learners' mental representations and increase their capacity to retain abstract information (Clark & Paivio; Vekiri).

In summary, according to the DCT, GOs or other graphical displays can help facilitate learning by allowing learners to store information in two separate, but interconnected forms of memory. Also, by making abstract verbal information more concrete through visual representations, more learning may occur.

Research Evidence for DCT

A number of research studies have focused on the DCT and graphical displays. A series of studies by Mayer and colleagues (Mayer & Moreno, 1998; Mayer, Bove, Bryman, Mars, & Tapanengco, 1996; Mayer, Steinhoff, Bower, & Mars, 1995; Mayer & Sims, 1994; Mayer & Anderson, 1992, 1991; Mayer & Gallini, 1990; Mayer, 1989a,b; Moreno & Mayer, 1999) tested the DCT in terms of recall of explanative information and problem solving (e.g., applying explanative information) using both static illustrations with text and animated diagrams accompanied by narration. In each of the studies, scientific processes (e.g., lightning) were taught to undergraduate students with varying degrees of background knowledge. Results from the studies indicated that students using static illustrations with text significantly improved application of explanative information, but recall of explanative information was only slightly better than the text-only control groups. The students using animated diagrams with narration demonstrated positive effects on both recall and application of explanative information. In each of the above studies, the researchers stress the GOs (static or animated) must be provided with guidance, or the learners may interpret them in misleading ways.

Based on DCT and the research studies of Paivio, Mayer, and their colleagues, Vekiri (2002) suggests four main characteristics for GOs to be successful. First, GOs need to address the goal of the task. For example, to illustrate cause/effect relationships, diagrams must show components of all systems and also how they interact and relate to each other. Second, GOs should be provided along with explanations and guidance. The studies presented herein support Paivio's (1983) claim that pictures enhance understanding of complex material, but only with explanations and guidance. Without these, learners are likely to draw wrong conclusions from what they see (Vekiri). Third, GOs need to be spatially coordinated with text. The studies by Mayer and colleagues support that providing material in both verbal and visual format enhances learning (Clark & Paivio, 1991), but only when spatially close. Mayer and Anderson (1992) termed this the *contiguity principle*. Simultaneous verbal and visual material may help learners develop deeper and more concrete mental representations because they see connections between the illustrations and text. However, if presented separately, learners may not be able to integrate the material as successfully. Fourth, GOs incorporating animation may be beneficial. While the studies supported both static and animated GOs for problem solving and recall, overall performance by students with animated GOs was slightly better than the students using static GOs (Vekiri).

In summary, DCT claims there are two separate, but interconnected systems (e.g., verbal and visual) involved in storing information in the brain. GOs can facilitate learning because graphics make abstract concepts more concrete and mental imagery lightens the load of working memory, allowing for faster and more accurate processing than verbal representations alone.

Conjoint Retention Hypothesis

The conjoint retention hypothesis (CRH) was first introduced by Kulhavy et al. (1993a, 1994) to “explain how geographic maps facilitate information acquisition from a subsequently studied text” (Vekiri, 2002; p. 292). The CRH is actually not a unique theory, but an interpretation of the DCT. It contains two basic assumptions. The first, identical to the DCT, is there are two separate, but interconnected systems (e.g., verbal and visual) used to remember information. The second, unique to the CRH, is the computational assumption. This assumption relates to the representational properties of maps (Kulhavy et al., 1993a). According to the CRH, maps are better than text alone in transmitting information, because they keep their visuospatial properties intact. According to Vekiri, this means maps have both individual features (e.g., size and shape) and information about spatial relationships among those features (e.g., distance, boundaries). In an applied setting, learners would receive a GO (e.g., geographic map, concept diagram) before reading a text or attending to a lecture. According to the CRH, by first encoding the GO (e.g., map), working memory will be under less stress when presented with the verbal information, and thus facilitate better recall and understanding of concept relationships.

Research Evidence for CRH

A number of research studies have focused on the CRH and GOs. The research of Kulhavy and colleagues (Kulhavy et al., 1993a, 1993c; Kulhavy et al. 1992) best illustrates this line of research. In a typical study, the researchers used college students to find if a GO (e.g., geographic reference map) given prior to hearing a narrative facilitated recall of verbal content and map reconstruction. For example, in the Kulhavy et al. (1993a) study, researchers developed a map of the Italian city of Ricordi. The map contained a total of 18 landmarks and paths surrounded on three sides by a wall. The map without icons had all of the drawings removed, leaving only the verbal labels in their identical locations. The text presented in the experiment was a 750-word narrative titled *The Old City of Ricordi*. The passage described both historical and current events occurring in Ricordi, with the first and last paragraphs consisting of sensible filler material. Each of the 18 features in Ricordi was mentioned exactly twice in the text, each time in a separate sentence. Each time a feature was mentioned it was linked to an event in the same sentence. The students were tested on how well they could recall the 18 features on the map and on factual recall of the narrative. Results demonstrated recall of verbal material was directly related to how well the learner encoded the GO. Those in the GO group better recalled the map features and significantly outperformed the control group on the test of factual knowledge. The researchers claim this is evidence for the CRH. However, in a later review (Griffin & Robinson, 2005), the reviewers contend the results in the Kulhavy studies lend better support to the DCT than the CRH. They contend the mimetic icons (e.g., icons representing features) themselves were the greater stimulus for factual recall rather than the spatial characteristics of the maps and there is no compelling evidence that the students encoded the map as an intact unit.

In summary, the CRH claims that students recall more text information when they study geographic maps in addition to text than when they study text alone, because the maps are encoded spatially (Kulhavy et al., 1985). Research evidence demonstrates some positive correlations between studying maps before reading text; however, it remains unclear if the advantages are due to the assumptions of the CRH or relate back to the assumptions of the DCT.

Discussion and Implications for Students with LD

According to each of these hypotheses, the presence of GOs along with other verbal information (e.g., text or lecture) has additive effects on learning because visual information is represented separately from verbal information in long-term memory (Vekiri, 2002). However, Larkin and Simon (1987) concluded only “computationally efficient” (e.g., relationships more explicit than implicit) displays are effective for learning. Based on research published since Larkin and Simon’s seminal work, researchers have found patterns in VAH, DCT, and CRH that support specific design principles that may achieve computational efficiency. A general principle supported by all three theoretical perspectives is that GOs are effective when they address the limitations of working memory in their design. This is consistent with the work of Swanson and Kim (2005) who found students with LD performed significantly better on problem solving tasks when stress on the working memory was minimized. This principle is shown in each of the three design points below:

1. GOs are computationally efficient when they minimize the processing required for their interpretation. GOs are most efficient when their interpretation relies more on visual perception because visual perception is carried out automatically without imposing heavy cognitive load (Vekiri, 2002). This lends itself to designing GOs based on Gestalt principles (e.g., proximity and connectedness). For example, when individual pieces of important information are spatially grouped together or connected (e.g., concepts on a GO), readers are likely to perceive them as being interrelated and to draw perceptual inferences about their relationships instead of engaging in further computations (Vekiri).
2. When material is presented in multiple sources (e.g., text and GOs) cognitive processing is demanding because learners must simultaneously attend to each source and integrate their information. As a result of limitations of the working memory, this could result in students failing to integrate material from various sources coherently and negate any possible advantage of the GO. Therefore, GOs can best facilitate cognitive processing if: (a) various sources

of information are presented simultaneously and are spatially close (Moreno & Mayer, 1999); (b) information is presented in different modalities, so that, according to DCT, it is processed by different cognitive systems without overloading working memory (Moreno & Mayer). This could be accomplished by verbal information being provided in the form of auditory narration and processed by the verbal system. The GO would be processed by the visual system; and (c) GOs are not clustered with a lot of information; readers can easily perceive the phenomena or relations that are important (Vekiri).

3. When geographic or concept maps are used as reference materials to facilitate learning from text or lecture, their effectiveness is maximized when they are provided before or concurrently with the text or lecture (Vekiri, 2002), other types of GOs (e.g., sequential, hierarchical, temporal, comparative, etc.) are effective before, during, or after a lesson (Amer, 1994).

For students with LD, the design of effective and efficient GOs is paramount. In addition to the above principles for GO design, two other principles seem to have special meaning for students with LD: (1) it has been suggested that students with little prior knowledge or below-average verbal ability may not know what elements in the GO are important to attend to and consequently process information at a superficial level (Vekiri, 2002). To assist these learners, GOs need to be accompanied by explanations (e.g., labels or notes embedded in the GO) that may better cue learners to the most important graphical elements and details; and (2) Each line of research for the three design theories also suggests GOs should be explicitly and directly taught to the learners when possible.

This is especially the case for students with LD, as direct instruction has consistently proven superior to other teaching methodologies (Hughes & Archer, in press; Adams & Carnine, 2003).

Implications for Practice and Future Research Directions

Based on the research examining both the benefits of GOs and the effective design of GOs, several key findings are consistently replicated and may offer direct implications for applied practice:

1. *Students with low verbal ability gain more from GOs than students with high verbal ability.*
2. *Students with little or no prior knowledge in a subject gain more from GOs than students with an abundance of prior knowledge in a subject.*
3. *GOs are especially helpful in assisting students with far-transfer tasks; in addition to near transfer tasks and factual recall.*
4. *GOs should be explicitly taught to students for maximum impact.*
5. *GOs should spatially group together or connect concepts so readers are more likely to perceive them as being interrelated and to draw perceptual inferences about their relationships.*
6. *GOs should not be clustered with a lot of information; readers should easily perceive the phenomena or relations that are important.*
7. *GOs are effective because of their computational efficiency; minimizing stress on the working memory.*
8. *GOs can be effective when used before, during, or after a lesson.*

As students enter the intermediate and secondary grades, academic demands are heightened due to greater reliance on expository material (Schumaker & Deshler, 1988). Based on the above research, it is clear that GOs may greatly assist students with LD (and other students with low verbal ability and little prior knowledge) in connecting new material to prior knowledge, identifying main ideas and supporting details, drawing inferences, and creating effective problem-solving strategies (Kim et al., 2004); key functions in the intermediate and secondary grades. However, each of the studies in this review used college students as participants. Future research should investigate the same GO issues with intermediate and secondary level students. This would detect any developmental difference issues; and, students with extremely low verbal ability may not have continued on to college. Therefore, effects for these students should be examined.

It is also important to consider the challenges of working in an intermediate or secondary classroom where the main focus is covering large amounts of content. As many students with LD are fully included with non-disabled peers in core content classes, it is important to closely examine any content enhancement (e.g., GO) that requires explicit instruction in addition to the main content (Gajira et al., 2007), per the above recommendations. Future research should also examine GO practice in cooperative teaching environments, wherein the special education teacher develops and teaches the GO as an enhancement to the content. Examination of GOs with differing amounts of information (e.g., high, medium, low) is also warranted as GOs with too much information may conflict with cognitive structures already established in more knowledgeable students, but significantly assist less knowledgeable students (Nesbit & Adesope, 2006). A wide array of students (e.g., low to high verbal ability and low to high prior knowledge) can be expected in any given included intermediate or secondary classroom (Gajira et al.)

Another area of warranted future research includes the use of GOs and technology. Based on the DCT, the use of animated graphics on a computer may have a significant impact on retention of verbal material (Paivio, 2007). However, there has been scant research in the special education literature concerning GOs and technology.

Finally, each of the studies in this review used pre-constructed GOs. When students learn from pre-constructed GOs they develop their understanding by internalizing information (Vekiri, 2002). When students self-generate GOs, it may involve different cognitive processes (Cox, 1999) as the students must develop an understanding of the concepts before they can represent their thinking. Teacher-developed versus student-developed GOs should be studied further in the future to determine the best application of each practice.

Appendix B

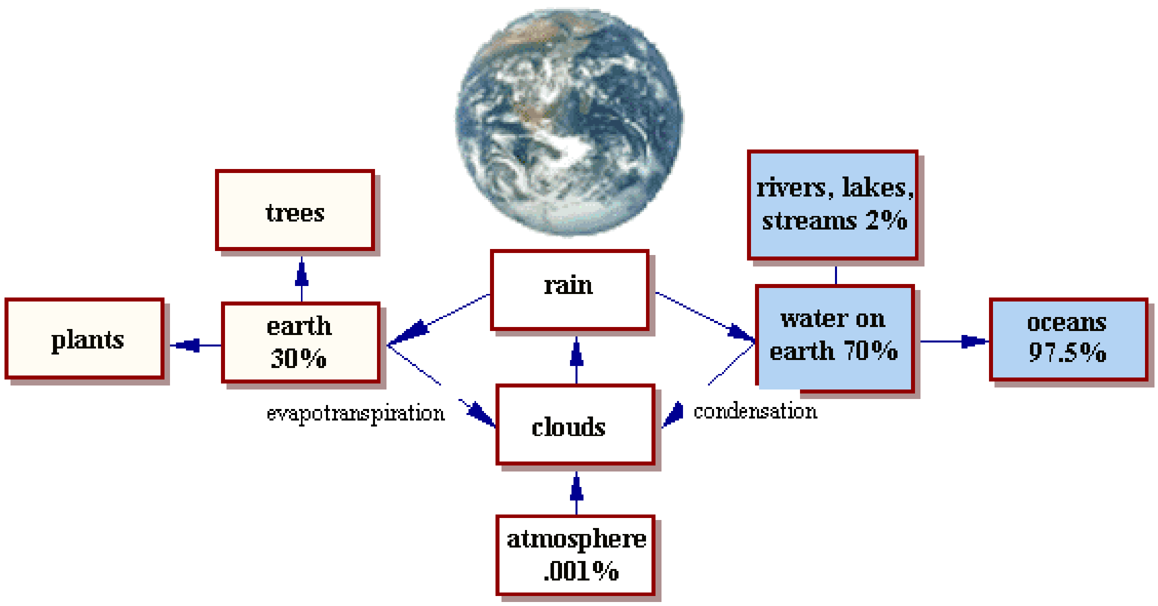
Meta-Analysis of Graphic Organizer Research with Students with LD

What are Graphic Organizers?

GOs are visual and spatial displays that make relationships more apparent between related facts and concepts (Hughes et al., 2003; Kim et al., 2004; Gajria et al., 2007). They are intended to promote more meaningful learning and facilitate understanding and retention of new material by making abstract concepts more concrete and connecting new information with prior knowledge (Ausubel, 1968; Mayer, 1979). While there is inconsistency in definition of types of GOs (Rice, 1994), we find five categories of GOs most prevalent in studies of students with LD:

Cognitive Mapping. Cognitive mapping assists in making major ideas and relationships explicit by using "lines, arrows, and spatial arrangements to describe text content, structure, and key conceptual relationships" (Darch & Eaves, 1996; p. 310). Boyle and Yeager (1997) also point out that minimizing sentences and details in the GO is an essential component of cognitive mapping. They recommend using keywords and simple drawings rather than complex sentences or elaborate drawings. An example of a cognitive mapping GO is found in Figure 1.

Figure 1. *Cognitive Mapping Example*

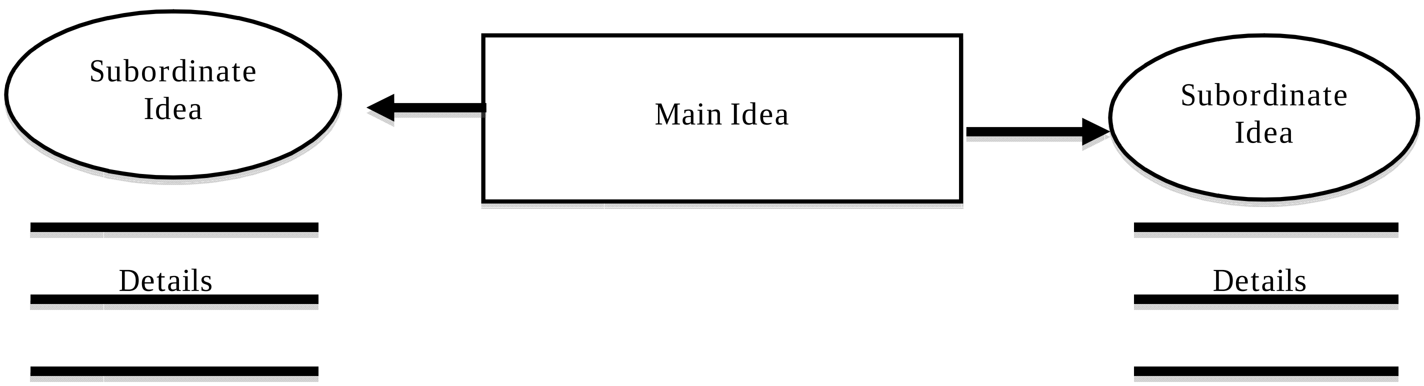


Downloaded from:

http://www.studygs.net/mapping/

Semantic Mapping. Semantic mapping (SM) is a heuristic that enables students to recognize relevant information from lecture and text (e.g., main ideas, important supporting details) and organize that information for written or oral retell (Washington, 1988). In SM, students or the teacher create a visual representation of new or difficult vocabulary and any relationships existing among the different vocabulary (Bos & Anders, 1990; Pearson & Johnson, 1978). In addition, when teaching this type of GO, a teacher presents critical attributes of a concept along with examples and non-examples to help promote student discrimination and generalization (Deshler et al., 1996). Figure 2 provides an example of an SM GO.

Figure 2. *Semantic Mapping Example*



Semantic Feature Analysis. Semantic Feature Analysis (SFA) is similar to SM in presenting concept characteristics and examples; however, non-examples can be inferred directly from the chart (Darch & Gersten, 1986). In SFA, a relationship matrix is constructed with vocabulary representing the coordinate concepts placed along the top of the matrix, and the vocabulary representing the subordinate concepts placed along the side (Bos & Anders, 1990). The superordinate concept serves as the title. Figure 3 provides an example of an SFA GO.

Figure 3. *Semantic Feature Analysis Example*

Comparison of Dog Breeds

	Basset Hound	Old English Sheepdog	Brittany Spaniel	Border Collie
Energetic	-	+	+	+
Weekly Grooming	-	+	-	-
Good with Kids/Other Pets	+	+	?	-

Key: + = feature present; - = feature not present; ? = not sure

Syntactic/Semantic Feature Analysis. Syntactic/Semantic Feature Analysis (SSFA) is nearly identical to SFA with the addition of cloze-type sentences written based on the matrix (Bos & Anders, 1990). Cloze sentences contain blank spaces replacing new vocabulary words. Students must use the context of the sentence and the SFA matrix to fill in the blanks. An example of an SSFA GO is found in figure 4.

Figure 4. *Syntactic/Semantic Feature Analysis Example*

Comparison of Dog Breeds

	Basset Hound	Old English Sheepdog	Brittany Spaniel	Border Collie
Energetic	-	+	+	+
Weekly Grooming	-	+	-	-
Good with Kids/Other Pets	+	+	?	-

Key: + = feature present; - = feature not present; ? = not sure

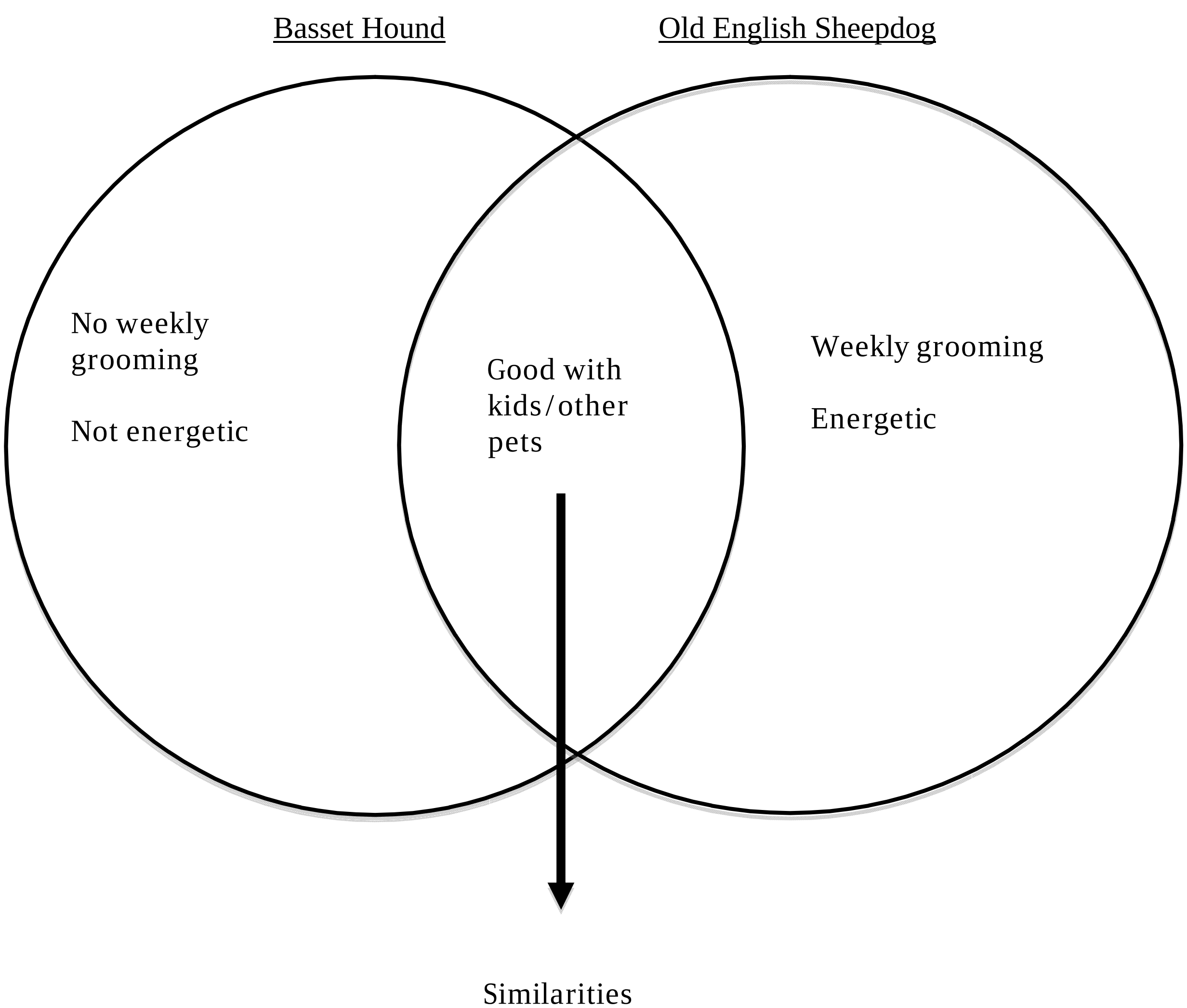
A(n) _________________ is the least energetic breed we have discussed.

A(n) _________________ requires at least weekly grooming.

A(n) _________________ and __________________ are good with other pets.

Visual Display. Visual displays present concepts or facts spatially, in a computationally efficient manner. That is, relationships between concepts are made apparent and clear by their location on the display. According to Hughes et al. (2003), in a visual display, facts or concepts are typically presented in one of five ways: temporal (e.g., timeline), spatial (e.g., decision tree), sequential (e.g., flowchart), hierarchal (e.g., taxonomy), or comparative (e.g., Venn diagram). An example of a visual display GO is found in figure 5.

Figure 5. *Visual Display Example*



Previous Research

Several groups of researchers have conducted reviews and meta-analyses of the effectiveness of GOs with non-disabled students (e.g., Nesbit & Adesope, 2007; Robinson, Katayama, DuBois, & Devaney, 1998; Kulhavy, Stock, & Caterino, 1994; Moore & Readence, 1984; Mayer, 1979; Ausubel, 1968). Based on these examinations of both the benefits of GOs and the effective design of GOs, several key findings are consistently replicated: (a) students with low verbal ability gain more from GOs than students with high verbal ability; (b) students with little or no prior knowledge in a subject gain more from GOs than students with an abundance of prior knowledge in a subject; (c) GOs are especially helpful in assisting students with far-transfer tasks; in addition to near transfer tasks and factual recall; (d)GOs should be explicitly taught to students for maximum impact; (e) GOs should spatially group together or connect concepts so readers are more likely to perceive them as being interrelated and to draw perceptual inferences about their relationships (f) GOs should not be clustered with a lot of information; readers should easily perceive the phenomena or relations that are important; (g) GOs are effective because of their computational efficiency; minimizing stress on the working memory; and (h) GOs can be effective when used before, during, or after a lesson. While these findings are promising, the vast majority of these reviewed studies used college students as participants, and there were few comparisons of students identified as LD.

Two research syntheses of school-aged children with LD (Gajria et al., 2007; Kim et al., 2004) have focused on GOs. In Gajria et al., as part of an examination of a number of content enhancements, GOs were found to have large effects for comprehension of expository text for secondary students with LD. Likewise, Kim et al. found large effects for GOs on the reading comprehension of elementary, intermediate, and secondary students with LD. However, drawing definitive conclusions from these reviews is problematic for several reasons. First, these reviews did not take sample sizes into consideration when calculating effect sizes and comparing studies. Second, the reviews focused solely on factual comprehension measures and not on vocabulary, inference, or relational comprehension. Third, there was no systematic analysis of effects by type of measure (e.g., near- or far-transfer), type of GO, subject area, or student stage of attending to verbal material. This lack of clarity makes it difficult to identify why the GO interventions were so effective.

For this study, we conducted a meta-analysis of GO research to address the following questions:

1. What are the overall effects of GOs on posttest performance of secondary students with LD?
2. Do these effects maintain over time?
3. Are there differential effects by type of measure (near- or far-transfer)?
4. Are there differential effects by type of GO?
5. Are there differential effects by subject area?
6. Are there differential effects by stage of attending to verbal material (before, during, after instruction)?

Method

Literature Search Procedure

A three-step process was used to identify studies using GOs with secondary students with LD. First, we conducted a comprehensive computerized search of PsycInfo, ERIC, and Social Science Citation Index databases for studies from 1960 to October

2009 using a list of search terms generated from previous reviews of GO studies (e.g., Nesbit & Adesope, 2006; Horton, McConney, Gallo, Woods, Senn, & Hamelin, 1993; Moore & Readence, 1984). We used the following combination of descriptors: *graphic organ*, expository, verbal, learning disab*, concept map, cognitive map, adolesc*, semantic map, semantic feature analysis, visual display*. Second, we conducted ancestral searches of identified articles, as well as the two most recent reviews of content enhancements used with students with LD (e.g., Gajria et al., 2007; Kim et al., 2004). Finally, we conducted hand searches of the following special education journals to locate the most recent literature: *Exceptional Children, Journal of Educational Psychology, Journal of Learning Disabilities, The Journal of Special Education, Learning Disability Quarterly, Learning Disabilities Research & Practice, Remedial and Special Education,* and *Reading Research Quarterly.* This process yielded a total of 27 published articles to analyze, many (e.g., 20) including more than one study.

Inclusion Criteria

We used six criteria to evaluate the appropriateness of each found study. First, the study must have included a dependent measure of near- or far-transfer of verbal (e.g., text or lecture) material and a GO as the independent variable. Studies with a mnemonic illustration rather than GO as the content enhancement (e.g., Brigham, Scruggs, & Mastropieri, 1995; Mastropieri, Scruggs, & Levin, 1987) were excluded, as effects could not be attributed solely to the GO.

Second, the study must have taken place in intermediate to secondary level classrooms (e.g., grades 4 – 12). This grade range was selected because it is typically when curricula become more complex and students are required to learn primarily through didactic lecture and expository text presentation (Fletcher et al., 2007; Hughes et al., 2003; Minskoff & Allsopp, 2003).

Third, based on the recommendations of Rosenthal (1994) and Lipsey and Wilson (1993), only studies using experimental or quasi-experimental group designs with control groups were included. Therefore, single-subject research studies (e.g., Gardill & Jitendra, 1999; Idol & Croll, 1987) and single-group studies (e.g., Boon, Fore III, Ayres, & Spencer, 2005; Sturm & Rankin-Erickson, 2002; Horton, Lovitt, & Bergerud, 1990; Bergerud, Lovitt, & Horton, 1988; Lovitt, Rudsit, Jenkins, Pious, & Benedetti, 1986; Sinatra, Stahl-Gemake, & Berg, 1984) were excluded.

Fourth, the study must have provided sufficient quantitative information (e.g., group means and standard deviations; *F* statistic) to permit calculation of an effect size (*ES*). One experimental study (Boyle & Weishaar, 1997) was excluded because it provided only multivariate analysis of covariance (MANCOVA) data without group means and standard deviations. According to Hunter and Schmidt (2004), there is no algebraically equivalent method to compute a comparable *ES* in this instance.

Fifth, participants in the experimental and control groups must have included students with LD. We defined LD the same way as Kim et al. (2004) in their research review and Swanson, Hoskyn, and Lee (1999) in their meta-analysis (e.g., average intelligence and poor performance in at least one academic or related behavioral area).

Finally, the study must have been published in a peer-reviewed journal and in English. This excluded any studies in *Dissertation Abstracts International* and unpublished studies from researchers in the field. While this criterion ensures only the highest quality research was included in this meta-analysis (Slavin,1995), it also represents a potential publication bias (Lipsey & Wilson, 2001; Lipsey & Wilson, 1993). This will be discussed further in the limitations section of this meta-analysis.

Study Coding

The first author coded pertinent study features including: participant characteristics (i.e., grade level, disability classification), subject area, type of GO, stated purpose, study contrasts, dependent measures, and reported findings. A graduate research assistant then double-coded this information and an interrater reliability of .97 was calculated. After discussion and clarification to resolve disagreements in coding, interrater reliability reached 1.00.

Individual Effect Size Calculation

Using methods described by Lipsey and Wilson (2001), standardized mean difference effect size was computed using pooled standard deviation. The formula used was:

$$ES_{sm} = \frac{\overline{X}_{G1} - \overline{X}_{G2}}{S_p},$$

where "$\overline{X}_{G1}$ is the mean for group 1, $\overline{X}_{G2}$ is the mean for group 2, and S_p is the pooled standard deviation" (Lipsey & Wilson, p. 48). When studies only provided an *F*-statistic, effect size was computed using a formula recommended by Thalheimer and Cook (2002). The formula used was:

$$d = \sqrt{F\left(\frac{n_t + n_c}{n_t n_c}\right)\left(\frac{n_t + n_c}{n_t + n_c - 2}\right)},$$

where n_t is the number of treatment subjects and n_c is the number of control subjects.

Next, to correct for upwardly biased effect sizes due to small samples, a Hedges correction (Lipsey & Wilson, 2001; Hedges, 1981) was utilized. The unbiased effect size estimate was computed using the following formulae:

$$ES'_{sm} = \left[1 - \frac{3}{4N-9}\right] ES_{sm},$$

$$SE_{sm} = \sqrt{\frac{n_{G1} + n_{G2}}{n_{G1} n_{G2}} + \frac{(ES'_{sm})^2}{2(n_{G1} + n_{G2})}},$$

$$w_{sm} = \frac{1}{SE^2_{sm}} = \frac{2 n_{G1} n_{G2} (n_{G1} + n_{G2})}{2(n_{G1} + n_{G2})^2 + n_{G1} n_{G2} (ES'_{sm})^2},$$

where N is the total sample size, ES_{sm} is the biased standardized mean difference, and $w_{sm} = \frac{1}{SE^2_{sm}}$ is the inverse variance weight used to calculate the weighted mean effect size. According to Hedges, Shymansky, and Woodworth (1989), the inverse variance weight is a better approach to account for the sample size of a given study than the more simple approach of weighting by sample size.

Outliers

Prior to analyzing the weighted mean effect size, extreme effect sizes that may have disproportionate influence on the analysis were eliminated (Lipsey & Wilson, 2001). Based on the recommendation of Burns (2004), eliminated outliers were effect sizes that were greater than 1.5 times the mean effect size.

Data Analysis

Following transformations and outlier elimination, data was analyzed by computing the weighted mean effect size:

$$\overline{ES} = \frac{\sum(w \times ES)}{\sum w},$$

where $\sum(w \times ES)$ is the summed product of the effect size and inverse variance weight and $\sum w$ is the summed inverse variance weight.

Next, the standard error of the mean effect size was computed using the following formula:

$$se_{\overline{ES}} = \sqrt{\frac{1}{\sum w}},$$

where $\sqrt{\frac{1}{\sum w}}$ is the square root of one divided by the summed inverse variance weight. The z-test for the weighted mean effect size was then computed by dividing the mean effect size by the standard error of the mean effect size, or in statistical notation:

$$Z = \frac{\overline{ES}}{se_{\overline{ES}}}.$$

Finally, using the z-test, the 95% confidence interval for the weighted mean effect size was computed using the following formulae:

$$\begin{aligned} Lower &= \overline{ES} - 1.96\left(se_{\overline{ES}}\right) \\ Upper &= \overline{ES} + 1.96\left(se_{\overline{ES}}\right). \end{aligned}$$

Homogeneity Analysis

Homogeneity analysis tests whether the assumption that all of the effect sizes are estimating the same population mean is reasonable (Hunter & Schmidt, 2004). Furthermore, Lipsey and Wilson (2001) contend that single mean effect sizes by themselves are not sufficient descriptors of the distribution. Therefore, we computed a *Q*-statistic to test homogeneity, using the formula:

$$Q = \sum(w \times ES^2) - \frac{\left[\sum\left(w \times ES\right)\right]^2}{\sum w}.$$

The *Q*-statistic is distributed as a chi-square with degrees of freedom (df) equaling number of *ES*s – 1. In our analysis of all studies, the critical value for a chi-square with df = 47 and p = .05 is 64. Because our calculated *Q*-statistic (57.2) is less than this critical value, we can fail to reject the null hypothesis of homogeneity and assume a fixed effects model, under which the variability across effect sizes does not exceed what would be expected based on sampling error. However, Lipsey and Wilson warn that a nonsignificant *Q*-statistic "does not always provide great confidence that a fixed effects model is justified" (p. 117). Because we do not have a large number of effect sizes and the corresponding samples are relatively small, the *Q*-statistic may not have sufficient statistical power. Therefore, we also fit a random effects model, which assumes sampling error plus other sources of variability assumed to be randomly distributed (Lipsey & Wilson). The random effects model is also a more conservative estimate than the fixed effects model of differences between moderating variables (Hunter & Schmidt).

Wherein the fixed effects model weights each study by the inverse of the sampling variance, the random effects model weights each study by the inverse of the sampling variance plus a constant that represents the variability across the population effects (Lipsey & Wilson, 2001). The formulae are as follows:

$$w_i = \frac{1}{se_i^2 + \hat{v}_\theta},$$

$$\hat{v}_\theta = \frac{Q_T - k - 1}{\sum w - \left(\frac{\sum w^2}{\sum w} \right)},$$

where $\hat{v}_\theta$ is the random effects variance component. We reran the analysis using this new weight to fit the random effects model.

The preceding analyses were conducted for posttest measures, maintenance measures, and differential effects of individual levels of independent variables (e.g., GO type, subject area) and dependent variables (e.g., near- or far-transfer measures). Because it was possible to fail to reject the null hypothesis of homogeneity, we will present results for both the fixed effects and random effects model for comparison. Cohen's (1988) criteria for interpreting strength of effect sizes (small *ES* < .20, medium *ES* = .50, large *ES* > .80) were used to gauge the magnitude of the findings in this analysis.

Results

A total of 55 unique posttest effect sizes were extracted from studies in 16 published articles meeting our inclusion criteria. For the purposes of this analysis, each unique effect size was considered an individual estimate of effect. (Included articles are marked with an asterisk in the Reference section.) In addition, eight of the published articles included maintenance data rendering 29 more unique effect sizes. Table 1 includes detailed information on each included study, participants, variables, measures, and individual effect sizes.

Table 1

Independent Variables, Dependent Measures, and Effect Sizes of Individual Experiments

Study/Participants	Subject Area	GO Type/ Contrast	Near- or Far-Transfer	Dependent Measure	Effect Size Posttest *M*	Maintenence *M*
Anders, Bos, & Filip (1984); 62 high school students with LD	Social Studies	SFA vs. Definition Instruction (DI)	Near	Researcher-generated Comprehension Test	1.71***	N/A
	Social Studies	SFA vs.DI	Near	Researcher-generated Vocabulary Test	1.49***	N/A
Bos & Anders (1990); 61 junior high students with LD	Science	SM vs. DI	Near	Researcher-generated Vocabulary Test	1.27***	.94**
	Science	SFA vs.DI	Near	Researcher-generated Vocabulary Test	1.03**	.66*
	Science	SSFA vs. DI	Near	Researcher-generated Vocabulary Test	.64	1.38***
	Science	SM vs. DI	Near	Researcher-generated Comprehension Test	1.33***	.54
	Science	SFA vs. DI	Near	Researcher-generated Comprehension Test	1.47***	.44
	Science	SSFA vs. DI	Near	Researcher-generated Comprehension Test	1.18**	1.40***
Bos & Anders (1992) Study 1; 42 upper-elementary	Social Studies	SM, SFA, & SSFA vs. DI	Near	Researcher-generated Comprehension Test	.81	.86

students with LD						
	Social Studies	SM, SFA, & SSFA vs. DI	Near	Researcher-generated Vocabulary Test	.50	1.15
Bos & Anders (1992) Study 2; 61 junior high students with LD	Science	SM, SFA, & SSFA vs. DI	Near	Researcher-generated Comprehension Test	1.22	.78
	Science	SM, SFA, & SSFA vs. DI	Near	Researcher-generated Vocabulary Test	.92	1.01
Bos & Anders (1992) Study 3; 47 upper-elementary students with LD	Social Studies	SM, SFA, & SSFA vs. DI	Near	Researcher-generated Comprehension Test	1.46	N/A
	Social Studies	SM, SFA, & SSFA vs. DI	Near	Researcher-generated Vocabulary Test	1.28	N/A
Bos & Anders (1992) Study 4; 53 junior high students with LD	Science	SM, SFA, & SSFA vs. DI	Near	Researcher-generated Comprehension Test	1.51	1.51
	Science	SM, SFA, & SSFA vs. DI	Near	Researcher-generated Vocabulary Test	.83	.79
Bos & Anders (1992) Study 5; 26 upper-elementary students with LD	Social Studies	SM vs. Normative	Near	Researcher-generated Comprehension Test	.42	.62*
	Social Studies	SFA vs. Normative	Near	Researcher-generated Comprehension Test	.30	.06

Bos & Anders (1992) Study 6; 22 junior high students with LD	Science	SM vs. Normative	Near	Researcher-generated Comprehension Test	2.16***	.78*
	Science	SFA vs. Normative	Near	Researcher-generated Comprehension Test	.17	.73*
Bos, Anders, Filip, & Jaffe (1989); 50 high school students with LD	Social Studies	SFA vs. Dictionary Method	Near	Researcher-generated Comprehension Test	1.67***	.00
Boyle (1996); 30 junior high school students with LD or MMR	English/ Language Arts	Cognitive Mapping vs. Typical Reading Instruction	Near	Formal Reading Inventory	.34	N/A
	English/ Language Arts	Cognitive Mapping vs. Typical Reading Instruction	Near	Below Grade Level Literal Comprehension Test	.87**	N/A
	English/ Language Arts	Cognitive Mapping vs. Typical Reading Instruction	Near	On-Grade Level Literal Comprehension Test	1.33***	N/A
	English/ Language Arts	Cognitive Mapping vs. Typical Reading Instruction	Far	Below Grade Level Inferential Comprehension Test	.76**	N/A

	English/ Language Arts	Cognitive Mapping vs. Typical Reading Instruction	Far	On-Grade Level Inferential Comprehension Test	.96***	N/A
Boyle (2000); 24 high school students with LD or MMR	English/ Language Arts	Visual Display vs. No Training	Near	Literal Comprehension Test	1.14***	N/A
	English/ Language Arts	Visual Display vs. No Training	Near	Relational Comprehension Test	.91**	N/A
	English/ Language Arts	Visual Display vs. No Training	Far	Inferential Comprehension Test	.51	N/A
Darch & Carnine (1986); 24 upper elementary students with LD	Social Studies	Visual Display vs. Text-Only	Near	Researcher-generated Comprehension Test	1.73***	N/A
	Social Studies	Visual Display vs. Text-Only	Far	Researcher-generated Far-Transfer Comprehension Test	.64	N/A
Darch, Carnine, & Kame’enui (1986); 84 junior high school students with LD.	Social Studies	Visual Display vs. Directed Reading	Near	Researcher-generated Comprehension Test	.79***	N/A

	Social Studies	Visual Display vs. Directed Reading	Far	Researcher-generated Far-Transfer Comprehension Test	.82***	N/A
Darch & Eaves (1986); 22 high school students with LD	Science	Visual Display vs. Text-Only	Near	Researcher-generated Comprehension Test	1.29***	.35
	Science	Visual Display vs. Text-Only	Far	Researcher-generated Far-Transfer Comprehension Test	-.64	N/A
Darch & Gersten (1986); 24 high school students with LD	Science/ Social Studies	Visual Display vs. Basal Instruction	Near	Researcher-generated Comprehension Test	1.72***	N/A
	Science/ Social Studies	SFA vs. Dictionary Method	Near	Researcher-generated Vocabulary Test	1.66***	.00
DiCecco & Gleason (2002); 24 junior high students with LD	Social Studies	Visual Display vs. Guided Discussion	Near	Researcher-generated Fact Quizzes	.05	N/A
	Social Studies	Visual Display vs. Guided Discussion	Far	Relational Statements in Two Written Essays	.94**	N/A
Englert & Mariage (1991); 28 upper elementary students	English/ Language Arts	SM vs. Typical Reading Instruction	Near	Written Free Recall	1.84***	N/A

with LD						
Griffin, Simmons, & Kame'enui (1991); 28 upper elementary students with LD	Science	Visual Display vs. No Visual Display	Near	Researcher-generated Comprehension Test	.51	N/A
Hudson (1996); 21 junior high students with LD	Social Studies	Visual Display vs. Note-Taking Guide	Near	Researcher-generated Knowledge Test	1.58***	2.37***
	Social Studies	Visual Display vs. Note-Taking Guide	Far	Researcher-generated Inference Test	1.00**	2.08***
Ives (2007) Study 1; 30 high school students with LD	Mathematics	Visual Display vs. Control	Near	Teacher-generated test	.67*	N/A
	Mathematics	Visual Display vs. Control	Near	Researcher-generated test (concepts)	1.06**	.94**
	Mathematics	Visual Display vs. Control	Far	Researcher-generated test (system solving)	.16	.00
Ives (2007) Study 2; 20 high school students with LD	Mathematics	Visual Display vs. Control	Near	Researcher-generated test	.49	N/A
Mastropieri & Peters (2003); 20 junior high students	English/ Language Arts	Cognitive Organizer vs. List Illustration	Near	Researcher-generated Featured Item Recall Test	1.42***	N/A

with LD						
	English/ Language Arts	Cognitive Organizer vs. List Illustration	Far	Researcher-generated Nonfeatured Item Recall Test	1.06**	N/A
Reyes, Gallego, Duran, & Scanlon (1989); 61 junior high students with LD	Science	SM vs. DI	Near	Researcher-generated Comprehension Test	1.27***	.94**
	Science	SFA vs. DI	Near	Researcher-generated Comprehension Test	1.03***	.66*
	Science	SSFA vs. DI	Near	Researcher-generated Comprehension Test	.64	1.38***
	Science	SM vs. DI	Near	Researcher-generated Vocabulary Test	1.33***	.47
	Science	SFA vs. DI	Near	Researcher-generated Vocabulary Test	1.47***	.44
	Science	SSFA vs. DI	Near	Researcher-generated Vocabulary Test	1.18***	1.40***

Note. ***= $p < .001$; **= $p < .05$; *= $p < .1$

Instructional Context

Each of the studies included instruction on the use of a GO. The majority of studies (Anders, Bos, & Filip, 1984; Bos & Anders 1990, 1992; Boyle 1996, 2000; Darch & Carnine, 1986; Darch, Carnine, & Kame'enui, 1986; Darch & Eaves, 1986; Darch & Gersten, 1986; DiCecco & Gleason, 2002; Englert & Mariage, 1991; Griffin, Simmons, & Kame'enui, 1991; Hudson, 1996; Ives, 2007; Reyes, Gallego, Duran, & Scanlon, 1989) incorporated aspects of direct, explicit instruction (e.g., modeling, prompted practice). The authors of the remaining study (Bos, Anders, Filip, & Jaffe, 1989) reported that written guidelines for teaching the GO were developed; however, these guidelines were not included in the article.

Generally, instruction for the experimental groups included one to two sessions focused solely on how to use the GO, one to two sessions of prompted practice using the GO, and independent student use of the GO for the remainder of sessions. During the initial sessions the teacher or researcher presented the GO to students and described how it illustrated relationships. For example, Darch and Carnine (1986) presented their visual display via overhead projector and students followed along while the teacher followed a script to describe the various cells in the display and their interrelationships. The following sessions generally included the instructor explicitly guiding the students in creating or filling out the GO. For example, Bos and Anders (1990) explicitly prompted the students in each step of creating a hierarchical semantic map from a vocabulary list. This level of assistance was then gradually faded. For instance, Darch and Gersten (1986) first presented a visual display with all the cells labeled and prompted the entire group in answering questions about specific facts in the GO. The researchers followed this by guiding the students through a visual display that did not provide cell labels. Finally, individual students were prompted in labeling blank visual displays. Instruction in the remaining sessions generally focused on independent use of the GO by the students in addition to text or lecture presentations. However, in each of the visual display studies all of the content was presented solely through the GO.

Duration of each of the interventions lasted between one and seven weeks with an additional one to four weeks between posttest and maintenance measures. All of the studies were conducted in a resource classroom during or after the school day.

What are the overall effects of GOs on posttest performance of students with LD?

After the removal of six outliers, there was a large overall standardized effect of GOs on the posttest performance (e.g., multiple-choice comprehension, vocabulary, written recall) of students with LD across all studies ($\overline{ES}$ = .91, *SE* = .062) for both random and fixed effects models and a 95% confidence interval of .79, 1.03 for the random effects model. Table 2 provides the full comparison between the random and fixed effects models.

Table 2. *Overall $\overline{ES}$ for Fixed and Random Models*

				95% CI	
	$\overline{ES}$	*SE of* $\overline{ES}$	Z-test	Lower	Upper
Fixed Model	.9127	.062	14.677*	.79	1.03
Random Model	.9061	.062	14.615*	.78	1.02

Note. * = *p* < .001

Do these effects maintain over time?

Twenty-nine studies included maintenance measures. In each of these studies, measures consisted of multiple-choice comprehension or vocabulary items. These measures were given to students one to four weeks after the conclusion of the intervention studies.

The test of homogeneity for overall maintenance effects produced a non-significant *Q*-statistic (*Q* = 24.49, *cv* = 35.17). Therefore, similar to the overall posttest effects, results of both the random and fixed effects models are reported. After removal of five outliers, there was a medium overall effect for maintenance across all studies ($\overline{ES}$ = .56, *SE* = .074) with a 95% confidence interval of .41, .70 for the random effects model. Table 3 provides the full comparison between the random and fixed effects models.

Table 3. *Maintenance* $\overline{ES}$ *for Fixed and Random Models*

				95% CI	
	$\overline{ES}$	*SE of* $\overline{ES}$	Z-test	Lower	Upper
Fixed Model	.5625	.077	7.305*	.41	.71
Random Model	.5614	.074	7.586*	.41	.70

Note. * = $p < .001$

Differential Effects

Based on number of effect sizes and significant *Q*-values, the remaining analyses of differential effects are reported as the random effects model. This provides a more conservative estimate of effect.

Are there differential effects by type of measure (near- or far-transfer)?

Forty-five individual estimates of effect were calculated for near-transfer measures at posttest and 27 individual estimates of effect for maintenance. In all but two articles, near-transfer measures consisted of researcher-generated multiple-choice questions on material directly covered in the lessons. In the remaining two articles, Boyle (1996) used a standardized measure of reading comprehension and Englert and Mariage

(1991) used a measure of written free recall. Overall mean effect size was 1.07 for posttest and .78 for maintenance.

Ten individual estimates of effect were calculated for far-transfer measures at posttest and two individual estimates of effect for maintenance. These measures tested students' ability of applying knowledge to situations not directly covered in the text or lecture. For example, Hudson (1996) included the question "Name one way the environment influenced the culture of the Arctic tribes" (p. 81). The teacher never stated the causal relation between environment and culture; only facts about environment and culture were stated.

Like near-transfer, measures consisted of researcher-generated multiple-choice questions in all but one study. Boyle (1996) used a standardized measure for far-transfer. The overall mean effect size was .61 for posttest and .69 for maintenance. Table 4 provides the full comparison between near- and far-transfer measures.

Table 4. *Near- and Far-Transfer Random Effects Model*

	Posttest			Maintenance		
		95% CI			95% CI	
	$\overline{ES}$	Lower	Upper	$\overline{ES}$	Lower	Upper
Near-Transfer	1.065	.94	1.19	.7809	.63	.93
		n = 45			*n* = 27	
Far-Transfer	.6127	.36	.87	.6886	.07	1.31
		n = 10			*n* = 2	

Note. *n* = number of *ES*s

Are there differential effects by type of GO?

The types of GOs used in the studies matched with the definitions in the introduction to this analysis (e.g., cognitive mapping, SM, SFA, SSFA, visual display). However, in one article containing eight studies (Bos & Anders, 1992), the researchers used a combination of SM, SFA, and SSFA. The method they utilized to present their results prohibited disaggregation of the findings. Therefore, a sixth category (SM/SFA/SSFA Combination) was added to the analysis. Large posttest effects (e.g., .74 – 1.2) were found for all types of GOs except visual displays. Visual displays had a moderate effect (e.g., .74). There were no statistically significant differences between GOs with large posttest effects. For maintenance measures, SSFA and SM/SFA/SSFA combination had significantly larger effects than the other GO types (e.g., 1.39, 1.01). Table 5 provides the full comparison between types of GOs.

Table 5. *Type of Graphic Organizer Random Effects Model*

	Posttest			Maintenance		
		95% CI			95% CI	
	$\overline{ES}$	Lower	Upper	$\overline{ES}$	Lower	Upper
Cognitive Mapping	.8914	.58	1.21	N/A	N/A	N/A
		n = 7			*n* = 0	
Semantic Mapping	1.251	.94	1.56	.6925	.38	1.01
		n = 7			*n* = 6	
Semantic Feature Analysis	1.187	1.06	1.32	.3695	.23	.51
		n = 10			*n* = 8	
Sentactic/Semantic Feature Analysis	.91	.82	.99	1.39	.95	1.83
		n = 4			*n* = 4	
SM/SFA/SSFA Combinaiton	1.062	.93	1.19	1.013	.86	1.17
		n = 8			*n* = 6	
Visual Display	.7486	.56	.93	.7877	.42	1.16
		n = 19			*n* = 5	

Note. *n* = number of *ES*s

Are there differential effects by subject area?

Posttest effects were calculated for the subject areas of English/writing/reading, mathematics, science, and social studies. Large posttest effects were found for all subject (e.g., .96 – 1.05) areas except mathematics (e.g., .59). Mathematics had a moderate posttest effect and was significantly smaller than the other subject areas. Maintenance effects were calculated for mathematics, science, and social studies. Science had a large maintenance effect (e.g., .80) and was significantly larger than the moderate effects for mathematics and social studies. Table 6 provides the full comparison between GOs by subject area.

Table 6. *Subject Area Random Effects Model*

	Posttest			Maintenance		
		95% CI			95% CI	
	$\overline{ES}$	Lower	Upper	$\overline{ES}$	Lower	Upper
English/Writing/ Reading	.9612	.72	1.20	N/A	N/A	N/A
		n = 11			*n* = 0	
Mathematics	.5942	.21	.98	.4559	-.07	.99
		n = 4			*n* = 2	
Science	1.052	.88	1.23	.8035	.64	.97
		n = 23			*n* = 20	
Social Studies	1.037	.85	1.22	.6535	.38	1.03
		n = 19			*n* = 8	

Note. *n* = number of *ES*s

Are there differential effects by stage of attending to verbal material (before, during, after instruction)?

There was not enough information to quantify differential effects by stage of instruction. All but one study included GOs before and during instruction and not enough information was provided to disaggregate these data. One study, Englert & Mariage (1991), used GOs after instruction. The unstandardized effect size for a near-transfer, written free recall measure was large (*ES* = 1.84).

Discussion

As was found in previous research syntheses (e.g., Gajria et al., 2007; Kim et al., 2004; Moore & Readence, 1984), findings from this meta-analysis indicate that GOs improve the factual comprehension of secondary students with LD. Unlike these previous reviews, this analysis also indicates that GOs may improve vocabulary and inference/relational comprehension for students with LD. Overall, there was a large mean effect for posttest performance (*ES* = .91, *SE* = .06) and a moderate mean effect for maintenance (*ES* = .56, *SE* = .07). The significant drop-off from posttest to maintenance is consistent with the other GO research syntheses. The reasoning for the drop has been attributed to lack of clarity in the duration and length of intervention sessions needed to positively affect maintenance (Gajria et al.; Gersten, Fuchs, Williams, & Baker, 2001). The relatively short duration of the intervention studies (e.g., 1 – 7 weeks) may not have provided sufficient instruction time for students to use GOs independently. However, a closer look at effects by type of GO shows effect sizes for visual displays and SSFA were larger for maintenance than posttest. This may lend support to the visual argument hypothesis (Waller, 1981) that posits GOs that are structured in a way that easily facilitate understanding and perception of concept relationships are superior to more complicated GOs that may require instruction to recognize conceptual relationships

(Dexter & Hughes, 2010). The visual displays and SSFA were more computationally efficient than the other GOs. That is, they were simple enough for students to recognize conceptual relationships without teacher instruction. This may explain why maintenance effects were larger for these types of GOs.

This meta-analysis also separated results into near-transfer and far-transfer measures. Near-transfer results (i.e., measures applying knowledge to situations directly covered in the text or lecture) from this analysis indicate that GOs are effective strategies for improving factual recall, factual and relational comprehension, and vocabulary knowledge. Across all near-transfer studies, the mean effect size was large (*ES* = 1.07) and maintenance effects were moderate (*ES* = .78). Students using GOs significantly outperformed their peers receiving typical classroom instruction on near-transfer measures. Interestingly, more complicated GOs requiring intensive teacher instruction (e.g., SM, SFA) resulted in the largest effects for near-transfer posttest measures. This indicates that while these GOs are difficult to understand independently, with appropriate instruction they are superior to less complicated GOs for immediate factual recall.

Far-transfer results (i.e., measures applying knowledge to situations not directly covered in the text or lecture) from this analysis indicate that GOs may also improve inference skills and relational knowledge for secondary students with LD. Across all far-transfer studies, the mean effect size was moderate (*ES* = .61) and maintenance effects were moderate (*ES* = .69). It is interesting to note that for far-transfer measure maintenance effect sizes were larger than posttest effect sizes. Previous research has indicated students with LD typically perform poorly on far-transfer tasks due to their inability to detect underlying concepts in verbal information due to difficulty assimilating verbal information with previous knowledge (Suritsky & Hughes, 1991). This analysis demonstrates that GOs may bridge the connection of verbal information with prior knowledge and assisting students with LD in far-transfer tasks. This finding supports Mayer's (1979) assimilation theory that posits GOs that assimilate material to a broader set of past experiences allows superior transfer to new situations. This finding is also consistent with the research of Robinson and colleagues (Robinson, Katayama, Dubois, & Devaney, 1998; Robinson & Skinner, 1996; Robinson & Kiewra, 1995; Robinson & Schraw, 1994), comparing visual displays (e.g., tree diagrams, matrices, network charts) with traditional, non-graphic outlines. In each of the studies, groups of non-disabled college students using GOs and traditional outlines equally outperformed text-only groups in factual recall, but the GO groups significantly outperformed the outline and text-only groups in identifying concept relations and making far-transfer concept comparisons.

This analysis also examined effects of GOs by subject area. All subject areas had moderate to large effects for posttest and maintenance measures. The largest effects were in science (*ES* = 1.05 for posttest, *ES* = .80 for maintenance) and the smallest effects in mathematics (*ES* = .59 for posttest, *ES* = .46 for maintenance). The large effects in science may be explained by the unfamiliar, technical vocabulary and content often based on relationships between concepts (Lovitt et al., 1986). This type of content sets up nicely for computationally efficient GOs that make relationships explicit and clear. Also, students may rely more heavily on content enhancements like GOs when content seems strange or foreign. The small effects for mathematics may be explained by the fact that the information was much more abstract than the other subject areas. Use of GOs with mathematics concepts and solving systems of linear equations are only beginning in the field. Ives (2007) offers several implications for future research based on his initial study in this field. It will take time and more study to fully understand the effects of GOs on mathematics understanding.

Finally, a previous GO research synthesis (Moore & Readence, 1984) reported GOs presented as text summaries after instruction were more effective than GOs presented before or during instruction. This finding cannot be corroborated by this analysis because only one study (Englert & Mariage, 1991) used GOs after instruction. While this study had an extremely large effect size (1.84), more studies are needed to confirm this finding. The current analysis points to effective instruction and choice of GO to be more important than stage of attending to verbal material in effectiveness of the intervention.

Methodological Limitations

There are two methodological limitations to the conclusions of this analysis. First, is the possibility of a publication bias. According to Smith (1980), as well as Lipsey and Wilson (1993), published articles have a larger mean effect size than unpublished studies. This bias, also known as a “file-drawer” effect, happens because studies with null findings are less likely to be published by major journals, often leaving offending data in a researcher’s file drawer (Lipsey & Wilson, 2001). In this analysis, based on the advice from Slavin (1995), we purposefully selected only published studies to ensure the highest quality of research designs. While this eliminated our ability to compare mean effect sizes of published studies versus unpublished studies, we were able to utilize Rosenthal’s (1979) fail-safe *N* statistic, which was later adapted by Orwin (1983). This statistic determines "the number of studies with an effect size of zero needed to reduce the mean effect size to a specified or criterion level" (Lipsey & Wilson, 2001; p. 166). The formula is as follows:

$$k_0 = k\left[\frac{\overline{ES}_k}{\overline{ES}_c} - 1\right],$$

where k_0 is the number of effect sizes of zero needed to reduce the mean effect size to $\overline{ES}_c$ (criterion effect level), *k* is the number of current studies, and $\overline{ES}_k$ is the current weighted mean effect size.

Using this statistic, reduction of our overall weighted effect size of .91 to .50 would take 45 additional unpublished studies with an effect size of zero. While this may be a possibility, it is unlikely that there exist 45 additional null studies in researchers' file drawers.

Second, our 55 unique effect sizes or studies were culled from only 16 published articles. While this is an acceptable practice (Lipsey & Wilson, 2001), it does limit the generalizability of the findings because there were only 21 distinct samples of students with LD (Total *N* = 808). Therefore, caution should be observed in generalizing these findings to all secondary students with LD.

Individual Study Limitations

There are two limitations to the individual studies that warrant consideration. First, while each of the effect sizes in this analysis were based on differences between a treatment group and a control group, it is not clear if the control conditions provided an adequate standard to measure the effects of GO interventions (Gersten, Baker, & Lloyd, 2000). The control conditions in the included studies used primarily typical classroom practices (e.g., dictionary instruction) rather than more closely comparable practices (e.g., outlines, structured overviews, etc.). While this provides much evidence for GO effects over typical classroom practice, it does not provide information in comparing GOs with other researched practices (Kim et al., 2004).

Second, while results indicate large effects for vocabulary, inference, and comprehension, it is important to note that all but one study used measures that were researcher-created and closely tied to the content. While these measures should have good content validity, there is no way to measure broader construct validity. Only Boyle (1996) used a standardized measure for reading comprehension. This fact may limit the generalizability of these findings and questions the actual level of understanding obtained by students in the GO conditions.

Implications for Practice

The major implication for applied practice is, consistent with assimilation theory and the visual argument hypothesis; more instruction intensive types of GOs (e.g., SM, SFA) are better for immediate factual recall while more computationally efficient GOs (e.g., visual display, SSFA) are better for maintenance and transfer. This knowledge can help teachers in designing GOs for initial instruction and for re-teaching, studying, and retention purposes. For instance, a semantic map for initial instruction, followed by a simpler visual display for review and study will potentially maximize the effects of recall, maintenance, and far-transfer for students with LD.

Another implication for practice is regardless of GO type, a teacher must explicitly teach the students how to use the GO. Students with LD need explicit instruction to understand how concepts are related, to recognize differences between main and subordinate ideas, and to put all the pieces together to make a clear picture of the content being learned no matter how implicit a GO may seem. A teacher's use of effective instruction practices (e.g., modeling, corrective feedback, etc.) will positively impact the intervention's effectiveness.

Conclusions and Implications for Future Research

This meta-analysis found that, in comparison with activities such as reading text passages, attending to lectures, and participating in typical classroom practice (e.g., dictionary instruction), GOs are more effective for posttest, maintenance, and transfer measures. However, this finding must be tempered due to several issues.

First, each of the studies took place in self-contained resource classrooms. This may not be typical for modern secondary students with LD. As many students with LD are now fully included with non-disabled peers in core content classes, it is important to closely examine how GOs will work in this setting. The feasibility and practicality of GOs needs to be closely examined in general education settings and recommendations for effective use put forth.

Second, there is great need for GO replication studies. Only three articles in this meta-analysis were published in the past 10 years. More current group design, randomized control trials are needed to fully validate the benefits of GOs across all secondary students with LD.

Finally, for student independent practice, it was not always clear from the studies if the GO was used correctly or at all. For instance, when students independently filled in a blank GO, there was no reported procedure for ascertaining if they were properly labeling main and subordinate details. Likewise, several of the studies (e.g., Anders, Bos, & Filip, 1984; Bos & Anders, 1990; Bos & Anders, 1992) reported students had a GO and text to study for the posttests. They did not include a procedure to make sure the students were actually using the GO to study. These students may have been using the text as their study guide. This lack of control may somewhat negate the attribution of effects to the GO. Future research must tightly control for these potential problem areas.

Taking the above issues into account, the evidence in this analysis still should persuade educational practitioners to make well-planned and well-instructed use of GOs. There were no significant negative effects across any of the categories of analysis and no other identified detrimental effect. A thoughtful combination of types of GOs will help make the learning process more efficient for secondary students with LD.

Appendix C

Informed Consent Form for Social Science Research
The Pennsylvania State University

Title of Project: Using Graphic Organizers to Teach Content Area Material to Students with Learning Disabilities

Principal Investigator: Douglas D. Dexter, Graduate Student
207 CEDAR Building
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(814) 933-2600 ddd176@psu.edu

Advisor: Dr. Charles A. Hughes
207 CEDAR Building
University Park, PA 16802
(814) 865-1699 cah14@psu.edu

1. **Purpose of the Study:** The purpose of this research study is to examine the effects of using graphic organizers to teach middle or high school social studies content to students with and without learning disabilities.

2. **Procedures to be followed:** Your child will be asked to participate in an instructional activity that focuses on teaching social studies material using graphic organizers. The instruction will take place during your child's normal social studies class period. Your child will be asked to complete a 15 question multiple-choice pretest, a 20 question multiple-choice posttest, and a 20 question multiple-choice maintenance test.

3. **Duration:** It will take about 1.5 to 2 hours of your child's normal social studies classroom time to complete the entire study.

4. **Statement of Confidentiality:** Your child's participation in this research is confidential. The data will be stored and secured at 207 CEDAR building in a locked file cabinet. In the event of a publication or presentation resulting from the research, no personally identifiable information will be shared.

5. **Right to Ask Questions:** Please contact Douglas D. Dexter at (814) 933-2600 with questions or concerns about this study.

6. **Voluntary Participation:** Your decision to allow your child to be in this research is voluntary. You or your child can stop at any time. You and your child do not have to answer any questions you do not want to answer.

I give permission for my child, ______________________, to participate in this research study.

You will be given a copy of this form for your records.

____ ____________________
Parent Signature Date

Appendix D

Student Feudalism Passage

Feudalism

Feudalism is a political, social, and military structure developed in Europe during the Middle Ages. It centered on the upper class, the land they owned, and the peasants who worked on that land. The noble, or ruling class in the Middle Ages was very small; around 90 percent of the population at this time was peasants.

The church as well as the kings and queens had the most power. The kings and queens were referred to as lords. They owned and governed all the land and sent their sons off to become knights. The boys started their knight careers as pages. As a page, they learned the proper behavior to be a knight; this included a code of manners referred to as chivalry. Next, the page became a squire. During this stage the squires learned how ride a horse, use weaponry, and fight. The squire then moved on to become a knight. Knights spent their lives defending the church and fighting wars. Most knights were granted land in exchange for fighting and protection. Some knights eventually became lords.

The lords needed people below them to serve and help govern the land they owned. The lord would grant land to a vassal, who was a lesser noble. In return for land, the vassal would declare loyalty to the lord in a formal ceremony and promise to fight for him when necessary.

The land granted to the vassal was called a fief, and included everything on the land. The fief included the manor and all the peasants, or poor farmers, who farmed the land. The peasants farmed the land to support the lord and his family. Life as a peasant on the manor was not easy. Each manor produced or made almost everything they needed for daily living. Some peasants were free and operated independent businesses. They paid rent to the lord for use of the land and could leave the manor when they chose. Many of the peasants were referred to as serfs. Serfs were not independent and were forced to live and work on the manor their entire lives. Serfs were the property of the nobles and could not marry without asking permission.

Each manor included a castle where the nobles and their families lived. The castles were not very luxurious or comfortable, but they kept the nobles safe. The castles were dark and drafty and built for defense. Each castle was built on a hill and included high walls and a moat to keep out invaders. The placement of the castle on a hill provided protection and also allowed the nobles to keep watch of the manor. Although the castles were stuffy and uncomfortable, they were better than the one-room houses occupied by the peasants. The nobles in the castles ate, drank, and played games to occupy their time. The peasants worked in the fields or the home from dawn until dusk all day everyday.

Innovations in farming techniques occurred during this time on the manors. The three-field system revolutionized farming. Farmers realized that leaving a field empty for one year produced better soil. They began using a three-field rotation system. Other innovations include better plows, a waterwheel, and windmills. These farming innovations produced better food and more of it, which increased the population.

Appendix E

Essay Guide

Name: ____________________

Date: ____________________

Essay Title

____

I. Introductory Paragraph

A) Thesis (the main point of your essay)

____

B) Topic sentences / sub points that support your thesis

1. Topic sentence 1

____

2. Topic sentence 2

____

3. Topic sentence 3

____

II. Body Paragraph 1

A) Topic sentence 1

____

B) Supporting details

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III. Body Paragraph 2

A) Topic sentence 2

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B) Supporting details

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IV. Body Paragraph 3

A) Topic sentence 3

____

B) Supporting details

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____

V. Concluding Paragraph

A) Brief summary of thesis and sub points, or other kind of conclusion

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SELECTED PUBLICATIONS:

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Dexter, D.D., & Hughes, C.A. (2009). *Progress monitoring within a response-to-intervention model.* RTI Action Network Web, National Center for Learning Disabilities. site: http://www.rtinetwork.org
Dexter, D.D., Hughes, C.A., & Farmer, T.W. (2008). Responsiveness to intervention: A review of field studies and implications for rural special education. *Rural Special Education Quarterly*, *27*, 3 – 9.
Vostal, B.R., Hughes, C.A., Ruhl, K.L., Benedek-Wood, E., & Dexter, D.D. (2008). A content analysis of *Learning Disabilities Research & Practice*: 1991 – 2007. *Learning Disabilities Research & Practice*, *23*, 184 – 193.