DOCUMENT RESUME

ED 383 333 IR 017 188

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TITLE The Influence of Dominant Languages on the Effectiveness of Graphic Organizers in Computer-Based Instruction.

PUB DATE 95

NOTE 11p.; In: Proceedings of the 1995 Annual National Convention of the Association for Educational Communications and Technology (AECT), (17th, Anaheim, CA, 1995); see IR 017 139.

PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.

DESCRIPTORS Academic Achievement; *Cognitive Structures; *Computer Assisted Instruction; English; Grade 4; Intermediate Grades; Knowledge Representation; *Language Dominance; Language Proficiency; Limited English Speaking; Spanish

IDENTIFIERS *Graphic Organizers

ABSTRACT

Students' academic achievement scores have been found to improve with the use of graphic organizers. Unfortunately, most previous research on graphic organizers has been constrained to English speakers in secondary and higher education. This study examines the effectiveness of graphic organizers when used by fourth grade students engaged in computer based instruction. Additionally, whether the learners's dominant language (Spanish or English) influenced the effectiveness of graphic organizers. Immediate and delayed gain in academic achievement scores of all students was analyzed. Statistically and educationally significant differences were found in scores favoring students who used graphic organizers. Results also indicated that when using computer-based instructional programs with embedded graphic organizers, Spanish and English speaking students, as groups, did not vary on learning style to the point of significantly impacting academic achievement scores according to tests measuring short-term and long-term recall. Limitations of the study and suggestions for future research are examined. Concepts are illustrated in two figures, and data is summarized in three tables. (Contains 23 references.) (Author/MAS)

Title:

The Influence of Dominant Languages on the Effectiveness of Graphic Organizers in Computer-Based Instruction

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Abstract

Students' academic achievement scores have been found to improve with the use of graphic organizers. Researchers suggest this may be due to the way graphic organizers depict concepts and relationships between concepts. Unfortunately, most previous research on graphic organizers has been constrained to English speakers in secondary and higher education. To expand our knowledge on graphic organizers and increased learning, the effectiveness of graphic organizers when used by fourth-grade students engaged in computer-based instruction was examined. Additionally, whether the learners' dominant language (Spanish and English) influenced the effectiveness of graphic organizers was studied. A one-way analysis of variance was used to analyze immediate and delayed gain in academic achievement scores of all students. Statistically and educationally significant differences were found in scores favoring students who used graphic organizers over those who used lists of topics. A two-way analysis of variance identified no significant differences between language groups for the effect of graphic organizers on immediate or delayed tests. Limitations of the study and suggestions for future research are examined.

Background

Introduction

Cognitive psychologists generally agree that there are at least two distinct types of human knowledge -- *declarative* and *procedural* (Anderson, 1983; Jonassen, Beissner, & Yacci, 1993). Declarative knowledge is knowing what something is, but it does not imply knowing how to use that knowledge. Defining the word "computer" and identifying the number 24 on a number line are examples of declarative knowledge. Procedural knowledge is knowing how to do something. Knowing how to manipulate physical entities such as accessing a computer application, or mental manipulations such as subtracting two-digit numbers, are examples of procedural knowledge. Procedural knowledge is dependent on an awareness of an object or idea (declarative knowledge) even though we may not be able to articulate that knowledge (Jonassen et al., 1993).

But how does declarative knowledge evolve to the complex forms required for procedural knowledge? To help explain this transition, some psychologists propose an intermediate knowledge type in which facts and concepts learned as declarative knowledge are interrelated with one another to form complex systems. This interrelationship of information, and the way in which we mentally organize it, has been called *structural knowledge* (Diekhoff, 1983).

Structural knowledge can be thought of as a network of mental connections or relationships between pieces of declarative knowledge. As learners develop these structures, they more easily associate independent ideas. These connections allow learners to draw conclusions and understand relationships among concepts. As students begin to develop these underlying structures and organizations of declarative knowledge, they go beyond "knowing what" to a better understanding of "knowing why." Structural knowledge networks appear to create the interconnectedness of ideas that support the development of procedural knowledge.

A variety of techniques have been developed to elicit, represent, and convey structural knowledge (Jonassen et al., 1993). One method being employed in public education is *graphic organizers*. Graphic organizers are spatial metaphors that indicate relationships among concepts in a node-link-node visual display (Anderson, 1990; Jonassen, 1990; Jonassen et al., 1993). *Nodes* contain key concepts. *Links* depict unspecified relationships between nodes (see Figure 1).

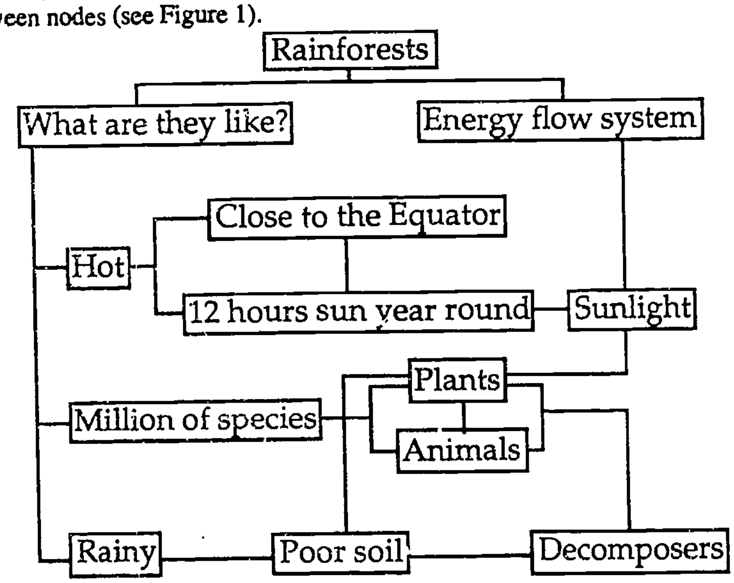

Figure 1. Sample graphic organizer.

Graphic organizers convey relationships and content structures in a pictorial fashion. These visual representations provide learners with a structural overview of information to be learned. This overview directs learner's attention towards key concepts and conceptual relationships rather than seemingly isolated facts. The use of graphic organizers enhances the understanding, organization, and long-term retention of information (Stevensold & Wilson, 1990) and accentuates meaningful learning and information manipulation (Jonassen, 1990; Kerchner, 1990; Peel, 1992). Graphic organizers also facilitate the extrapolation, combination, inference, and other logical reasoning mechanisms that allow learners to transfer and apply information (Jonassen et al., 1993).

Problem Statement

Graphic organizers improve the effectiveness of instruction. However, it cannot be assumed that they affect all students equally. In fact, researchers suggest that the effectiveness of any instructional strategy varies with *individual learner differences* (Dunn, 1990; Oxford 1990; Scarpaci & Fradd, 1985).

Individual learner differences include any personal trait or capability that influence the way students process and use information. Although there are a variety of differences that affect learning, dominant language is a key difference because it serves as a central means for information processing (Sticht, 1992). Dominant language differences do not imply a difference in intelligence, but rather in the way individuals organize and use information (Scarpaci & Fradd, 1985).

Previous research on the effectiveness of graphic organizers generally focused on Anglo-Americans in secondary and higher education. In a review of the literature, no studies were identified that included a bilingual (Spanish -- English) elementary school-aged population engaged in computer-based instruction. This omission limits the generalizability of previous research findings as to the effectiveness of graphic organizers to various populations.

Purpose of Study

The purpose of this study was two-fold: (a) to assess the effectiveness of graphic organizers in computer-based instruction for fourth-grade students, and (b) to determine the relationship between learner's dominant language (Spanish or English) and the effectiveness of graphic organizers in computer-based instruction by comparing mean gain scores across language groups. To accomplish this assessment, the experiment was structured so that gains in academic achievement scores of two groups of fourth-grade students after they engaged in computer-based instruction could be compared. One group accessed an instructional program with embedded graphic organizers; the second group accessed an analogous instructional program, but with embedded lists of topics. The term *embedded* refers to features contained within the programs. Gain score differences between pretest and posttests (immediate and delayed) were used to determine whether the type of embedded feature resulted in a difference in short-term and long-term recall.

Methods

Population and Sample

The population under study was fourth-grade students engaged in computer-based instruction. Students enrolled at a single elementary school in a suburb of San Diego, California, served as the accessible population. The sample used in this study was 68 fourth-grade students. Two fourth-grade classes with different teachers were included. The sample included 31 English speaking and 37 Spanish speaking students. English and Spanish speakers were defined by each individual's dominant language of instruction according to school authorities. We dropped three students from the study: Two students did not submit pretests and a third did not submit the delayed posttest. Each subject who completed all components of this study ($n = 65$), participated in a pretest, instructional program, immediate posttest (Posttest 1), and delayed posttest (Posttest 2).

Two important variables led us to choose the location for our study. First, 58% of the school's students are classified as Limited English Proficiency (LEP) or Non-English Language Background (NELB) students. As such, this district represents a microcosm of demographic changes that will soon be facing many California and United States schools in the near future as enrollment of sheltered English students increases. The LEP and NELB subjects in this school are almost all Spanish speakers with Mexican cultural backgrounds. Second, all students between second-grade and fifth-grade spend approximately 20 minutes per day engaged in computer-based instruction. Because of this exposure, and because the study involved computer-based instruction, test results should not be contaminated by the novelty effect that may have influenced results at other research sites.

Materials

Instructional programs. The instructional material included four versions of a computer-based program developed using IBM's "LinkWay™" software. The programs were designed to include content normally presented in the school's fourth-grade science curriculum and structured so that students could complete the instruction in 20 to 30 minutes.

We developed four analogous versions of the instructional program. Two versions were developed in English and two in Spanish. In each language, we developed one program with embedded graphic organizers and one with embedded lists of topics. The difference between the programs was the position of concept labels on the screen and the use of lines connecting these concept labels in the graphic organizers. Otherwise, the programs were identical. Figure 2 shows partial renditions of screens depicting this difference.

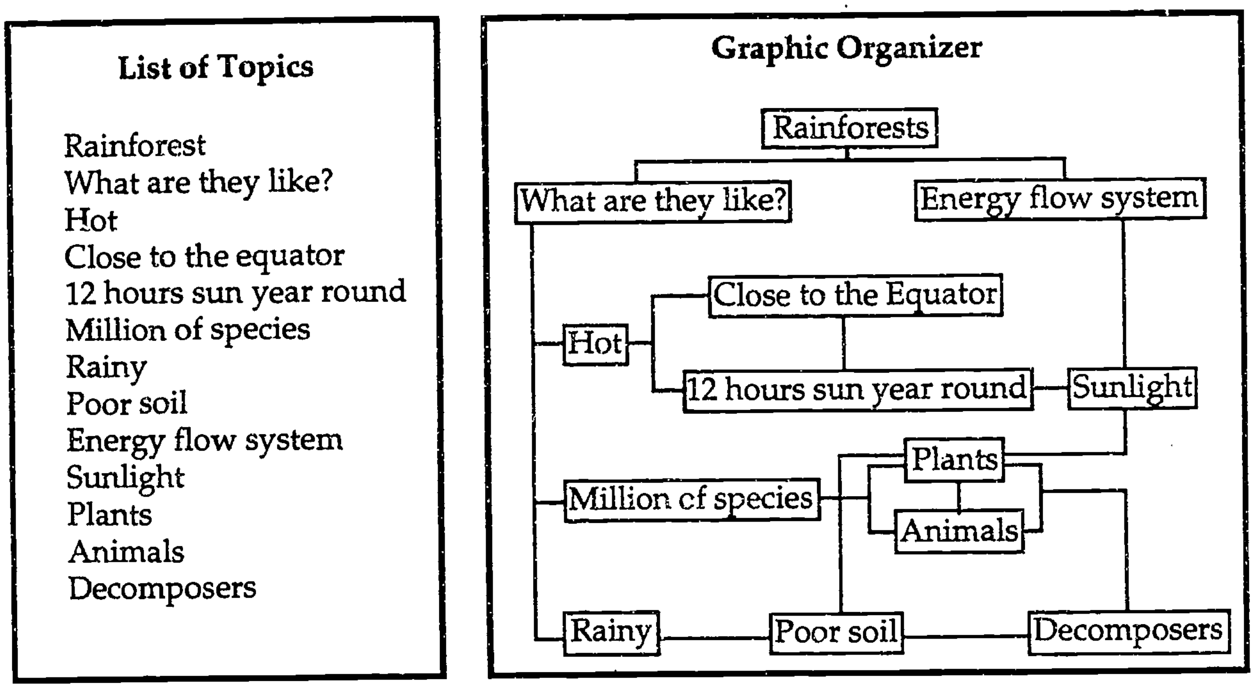

Figure 2. Renditions of lists-of-topics and graphic-organizer screens.

The programs consisted of 21 screens containing instructional information, 7 screens representing either lists of topics or graphic organizers, and 3 screens containing user directions and general information regarding the program's presentation.

Screens that presented lists of topics and graphic organizers were designed with three colors. Green identified what material users would see next in each treatment. Pink identified what was just viewed, and white indicated the overall content of material. The colors used in the list-of-topics and graphic-organizer screens served four purposes:

- to provide feedback to the learners on their progress through the program;
- to serve as a preview strategy, highlighting material to be learned (green);
- to serve as a review strategy, highlighting material just learned (pink); and
- to serve as a synthesized overview of all the information in the program (white).

Test Instruments. We developed two versions of the test to match the dominant language (English or Spanish) of the students. The pencil-and-paper academic achievement test consisted of 18 multiple choice questions from the facts, concepts, and rule/principle levels of Gagné's (1977) taxonomy of cognitive skills. Teachers at the treatment school conducted a face-validity measure of the test instrument prior to its use with students. We used the test to gather pretest, immediate posttest, and delayed posttest scores.

Treatment

A stratified sample of dominant English and dominant Spanish speakers were randomly assigned to two treatment groups: Treatment 1 students accessed graphic-organizer screens in the instructional program; Treatment 2 students accessed list-of-topics screens in an otherwise identical version of the program. Within both treatment groups, students accessed instruction developed in their dominant language. Dominant language (English and Spanish) and program type (graphic organizer and list of topics) served as independent variables. Mean gain score differences of achievement tests served as the dependent variables for group results.

The instructional program was limited to a one-shot, 20 minute treatment. All students were provided with a later opportunity to use the non-treatment program to ensure equal educational opportunities to all subjects.

The teachers' role was limited to administering the pretests, immediate posttest, and delayed posttest, and directing students to the computer where they accessed their pre-assigned instructional program.

The administration procedures for this study involved four steps. First, all students took the academic pretest matched to each individual's dominant language. Approxim ly one day later, students began using the treatment program. Because each classroom had only one available computer, students took turns using the program. After completing the program, students took the immediate posttest to measure their short-term recall. Approximately two weeks after the treatment students took delayed posttest to measure their long-term recall.

Experimental Design

An analysis of variance (ANOVA) statistical procedure was used to identify whether statistically significant differences existed between group mean gain scores. Gain scores were defined as the difference between pretest and immediate posttest scores (Gain 1), and the difference between pretest and delayed posttest scores (Gain 2). Gain scores were used to avoid the impact of individual differences on the level of content knowledge at the start of the study. Dominant language and program type were used as independent variables. Gain 1 and Gain 2 scores served as dependent variables.

We used a one-way ANOVA to determine if statistically significant differences existed between the means of the two treatment groups. To identify if statistically significance differences existed among the four subgroups (two languages by two treatments) a two-way ANOVA was conducted. A predetermined overall level of statistical significance was set at 0.05. The predetermined level of educational significance, as measured by the standardized mean difference effect size (calculated by dividing mean differences of the posttest by the standard deviations of the scores from the untreated groups) was set at 0.25 (Tallmadge, 1977).

Results

Overview of Descriptive Statistics

Table 1 presents mean gain scores, standard deviations, and sample sizes for the four treatment groups involved in this study. Mean gain scores are presented for two instances: Gain 1 (defined as the difference between immediate posttest scores and pretest scores) and Gain 2 (defined as the difference between delayed posttest scores and pretest scores).

Table 1

Means, Standard Deviations, and Sample Sizes for All Groups

		Gain 1		Gain 2		
Treatment	Groups	*M*	*SD*	*M*	*SD*	*n*
List of Topics	English	2.61	1.56	1.01	1.04	13
List of Topics	Spanish	3.58	2.17	1.63	1.85	19
Subtotal		3.19	1.94	1.14	1.70	32
Graphic Organizer	English	4.20	2.27	2.13	1.64	15
Graphic Organizer	Spanish	4.17	1.95	2.61	2.03	18
Subtotal		4.18	2.07	2.39	1.71	33
Total		3.69	2.02	1.90	0.20	65
Subtotal	Spanish	3.87	2.06	2.12	1.94	37
Subtotal	English	3.42	1.91	1.62	1.30	28

Information in Table 1 reveals that Gain 2 scores were lower than Gain 1 scores for all treatment groups. The reduction in gain scores reflects an expected decrease in the amount of information retained over time. Initial analysis indicated that in immediate and delayed recall tests, mean gain scores of both English and Spanish speaking groups using programs with embedded graphic organizers were higher than those achieved by their counterparts using programs with embedded lists of topics. These results lead us to believe, at least with descriptive statistics, that embedding graphic organizers in instructional programs is a better strategy to improve academic gains than embedding lists of topics in instructional programs for both Spanish and English speaking fourth-grade students.

Statistical and Educational Significance

Graphic organizers versus list of topics. From data in Table 1, the standardized mean difference effect size between groups was calculated using computer-based instructional programs with embedded graphic organizers and embedded list of topics. Effect sizes were identified to be 0.40 for Gain 1 scores and 0.51 for Gain 2 scores. An ANOVA was conducted for both Gain 1 and Gain 2 scores (see Table 2).

Table 2
Analysis of Variance: Comparison of Gain 1 and Gain 2 for English and Spanish Speakers Grouped by Program Type

Dependent Variable	Source	Degrees of Freedom	Sum of Squares	Mean Square	*F* test	Significance of one-tail *F* test
Gain 1	Between groups	1	16.06	16.06	3.99	$p = .04$
	Within groups	63	253.78	4.03		
	Total	64	269.84			
Gain 2	Between groups	1	15.84	15.85	5.32	$p = .01$
	Within groups	63	187.59	2.98		
	Total	64	203.44			

The information in Table 2 indicates that there was a statistically significant difference between treatment groups favoring graphic organizers on both short-term (Gain 1 scores) and long-term recall (Gain 2 scores). Previous researchers, as discussed earlier, indicated that graphic organizers within instructional material improved short-term and long-term information recall. Our findings support these conclusions. This experiment also extended research into the realm of computer-based instruction and elementary students. Evidence now exists which supports the idea that the use of graphic organizers in computer-based instructional programs has a significant positive effect on both short-term and long-term recall for fourth-grade students.

Dominant language differences. A two-way ANOVA was used to determine if the effectiveness of graphic organizers in computer-based instructional programs varied significantly by learner's dominant language. In this computation, program type and dominant language were used as independent variables and gain scores as the dependent variable. This analysis is shown in Table 3.

Table 3
Analysis of Variance: Comparison of Mean Scores for Graphic Organizer Users Grouped by Dominant Language

Dependent Variable	Source	Degrees of Freedom	Sum of Squares	Mean Square	*F* test	Significance of one-tail *F* test
Gain 1	Program	1	3.44	3.44	0.85	$p = .03$
	Language	1	18.74	18.74	4.64	$p = .36$
	Program X Language	1	3.95	3.95	0.97	$p = .33$
	Error	61	246.61	4.04		
Gain 2	Program	1	16.46	16.46	5.48	$p = .02$
	Language	1	4.23	4.23	1.41	$p = .24$
	Program X Language	1	0.02	0.02	0.01	$p = .93$
	Error	61	183.36			

Information presented in Table 3 indicates that there is no statistically significant difference at the 0.05 confidence level between language groups for the effect of graphic organizers in immediate (Gain 1) or delayed tests (Gain 2). These results indicate that the effectiveness of graphic organizers in computer-based instructional programs does not vary significantly by learner's dominant language. The standardized mean difference effect size calculated from Table 1 was 0.01 for Gain 1 scores and 0.19 for Gain 2 scores. These scores indicate that differences on the effect of graphic organizers between language groups are not educationally significant for either short-term or long-term recall.

Discussion

Implications of the Study

Two main implications can be deducted from the results of this study. First, the use of programs with embedded graphic organizers in computer-based instruction enhances short-term and long-term recall in fourth-grade students. The increase in academic achievement scores measuring long-term and short-term recall confirmed previous research findings. Second, results indicate that dominant language differences do not significantly impact the effectiveness of programs with embedded graphic organizers. The non-significant differences between dominant Spanish and dominant English speaking students were unexpected.

Researchers agree that the effectiveness of any learning strategy depends on context and content of instruction, and on individual learner's experience, cognitive maturity, motivation, and learning style (Oxford, 1990; Schmeck, 1983). In this study, context and content of instruction were analogous for all treatment groups. One assumption made was that subjects did not substantially differ in terms of their experience and cognitive maturity because they were at the same grade level, they were randomly assigned to treatment groups, and their pretest scores did not indicate statistically significant differences at the 0.05 level (Gimenez, 1994). Therefore, our results indicated that when using computer-based instructional programs with embedded graphic organizers, Spanish speaking and English speaking students, as groups, did not vary on leaning style to the point of significantly impacting academic achievement scores according to tests used in this study to measure short-term and long-term recall.

Theoreticians suggest that cultural background provides the most important resources for individual cognitive development (Connolly & Tucker, 1982; Stein, 1990; Sticht, 1992). Such resources refer to symbols and symbol systems, including natural language and conceptual knowledge. These are the primary tools for the transmission of cognitive abilities and motivational conditions (Sticht, 1992). Results of this study indicated that the different cultural backgrounds of dominant Spanish and dominant English speaking subjects did not significantly influence the effectiveness of graphic organizers embedded in computer-based instructional programs.

In searching for causes of academic achievement differences between dominant English and dominant Spanish speaking students, researchers determined differences in learning style preferences as key elements (Scarpaci & Fradd, 1985; Schaiper & Flores, 1985). These researchers suggested that culture strongly influences the way in which students learn and interact. Instead of faulting individual characteristics, studies on LEP and NELB native Spanish students identified that low scholastic achievement was related to instructional materials, instructional methods, classroom environments, and learning strategies that favor native English students (Dunn, 1990; Ulibarri, 1982). Recent studies determined that the United States educational system, at all levels of instruction, relies on the learning preferences of white middle-class students, and these preferences are not always shared by Mexican-Americans (Cohen, 1969; Connolly & Tucker, 1982). However, results of this study indicated that graphic organizers embedded in computer-based instructional programs significantly increased mean academic achievement scores of both groups, and did not significantly vary between dominant English and dominant Spanish speaking students.

Results of this study support previous theories suggesting that the use of graphic organizers is an effective strategy to increase short-term and long-term information recall. Although both groups had a decrease in Gain 2 scores reflecting long-term recall, this decrease was more pronounced for the group using programs with embedded list of topics. These results suggest that the use of computer-based instructional programs with embedded graphic organizers have their greatest impact on long-term recall. Although the study was limited to a one-shot 20 minute treatment, the results were significant. These findings, concluded from a single, short exposure to graphic organizers, foretell of potentially major cognitive growth in students who use this strategy for extended periods of time. Thus, educators and instructional designers can strongly encourage the use of embedded graphic organizers in instructional materials as means to enhance short-term and long-term recall of information.

Limitations of the Study

Given the characteristics of the study, several shortcomings are apparent. First, teachers did not monitor students during the treatment. It is possible that students did not complete the treatment or may have used the program assigned to a different group. However, data were consistent with previous studies. This consistency lends support to our conclusions. Second, the treatment was limited to a one-shot, 20-minute, computer-based instructional program. Although this short exposure was initially considered a weakness in our study design, it may also be viewed as supporting the strength of graphic organizers. Because students exhibited significant short- and long-term gains after a brief exposure, longer exposures to graphic organizers may generate even greater gains in academic scores.

Questions for Future Research

Questions and concerns for future research include the following:

1. Do graphic organizers embedded in computer-based instructional programs improve academic achievement scores when the graphics are used as navigation controls? This study focused on the use of graphic organizers as graphic representations of information. However, literature reveals that graphic organizers in computer-based instruction may also serve as navigational tools (Barba, 1993). The literature on learner control, however, is controversial. Some researchers suggest that because graphic organizers may be used as a nonlinear presentation controller, the impact on the instructional process may vary according to the learner's cognitive maturity, previous knowledge, learning style, and preferred leaning strategies. Researchers determined that although learner control is motivating, the lack of structure in the instructional sequence may cause barriers for some learners (Malone & Lepper, 1987).

2. Does the use of graphic organizers in computer-based instruction improve academic achievement scores when the organizers do not provide feedback on learner progress? Although this study focused on the use of graphic organizers as graphic representations of information, these organizers also served to provide feedback on learner progress. Feedback was provided by using colors to identify which concepts had just been explained, which were about to be viewed, and the overall structure of the lesson. Future research may replicate this study without the use of feedback to determine whether this feature was a critical variable for the effectiveness of graphic organizers in this study.

3. Does the use of graphic organizers in computer-based instruction improve academic achievement scores when they include labeled links? Explicitly labeling the relationships in a graphic organizer may cause information overload in students with lower cognitive capabilities. In this study, labeled relationships were avoided because it was assumed that they may impose extra cognitive processing leading to information overload for fourth-grade students. Researchers may want to compare the effectiveness of graphic organizers with and without labeled relationships with the population used in this study.

4. What are the characteristics of students who do not improve academic scores when they use computer-based instructional programs with embedded graphic organizers? A further study could identify characteristics of students who prefer to use lists of topics to graphic organizers by exposing learners to both strategies and allowing them to choose the strategy that has the greatest impact on their short-term and long-term recall (measured in terms of academic achievement scores). By identifying attributes of both groups of students, instruction could be tailored to better meet individual needs.

5. This study focused on Spanish and English speakers who are in a bilingual environment. Researchers may wish to replicate this study to include subjects in monolingual educational settings, and in settings with other than Spanish and English speakers.

References

Anderson, J. R. (1983). *The architecture of cognition.* Cambridge, MA: Harvard University Press.

Anderson, M. L. (1990). *Cognitive mapping as a bridge activity.* (ERIC Document Reproduction Service No. 320 140).

Barba, R. H. (1993). The effects of embedding an instructional map in hypermedia courseware. *Journal of Research on Computing in Education, 25*(4) 405-412.

Cohen, R. (1969). Conceptual styles, culture conflict, and nonverbal tests of intelligence. *American Anthropologist, 71*, 828-856.

Connolly, L. & Tucker, S. (1982). *Motivating the Mexican-American student.* (ERIC Document Reproduction Service No. 287 657).

Dickhoff, G. M. (1983). Relationship judgments in the evaluation of structural understanding. *Journal of Educational Psychology, 75*, 227-233.

Dunn, R. (1990). Cross-cultural differences in learning styles of elementary-age students from four ethnic backgrounds. *Journal of Multicultural Counseling and Development, 18* (2), 68-93.

Gagné, R. M. (1977). *The conditions of learning* (3rd ed.). New York: Holt, Rinehard & Winston.

Gimenez, F. (1994). *Effectiveness of graphic organizes in computer-based instruction.* Unpublished masters thesis, San Diego State University.
Jonassen, D. (1990). *Conveying, assessing, and learning (strategies for) structural knowledge.* (ERIC Document Reproduction Service No. 323 934).
Jonassen, D., Beissner, K., & Yacci, M. (1993). *Structural knowledge techniques for representing, conveying, and acquiring structural knowledge.* Hillsdale, New Jersey: Lawrence Erlbaum Associates, Publishers Hove & London.
Kerchner, C. (1990). *The reflective Macintosh: A computer-assisted approach to understanding and improving managerial practices. Project report.* (ERIC Document Reproduction Service No. 332 289).
Malone, T. W. & Lepper, M. K. (1987). Chapter 10: Making learning fun: A taxonomy of intrinsic motivation for learning. In R. E. Snow & M. J. Farr (Eds.), *Aptitude Learning and Instruction* Vol. 3, Cognitive and Affective Process Analysis , 223-253. Hillsdale, NJ: Lawrence Erlbaum.
Oxford, R. (1990). Strategy training for language learners: Six situational case studies and learning model. *Modern Language Journal, 73* (3), 197-216.
Peel , J. (1992). *Schematic maps: Cognitive tools for enhancing early stages of counseling.* (ERIC Document Reproduction Service No. 354 262).
Scarpaci, J. & Fradd, S. (1985). Latin-Americans at the university level: Implications for instruction. *Journal of Multicultural Counseling and Development, 13* (5), 183-189.
Schaiper, L. & Flores, J. (1985). *Perceptual learning style differences among Mexican American high school and university students.* (ERIC Document Reproduction Service No. 314 226).
Schmeck, R. (1983). Learning styles and classroom evaluation methods: Different strokes for different folks. *College Student Journal, 17* (1), 94-100.
Stein, R. (1990). Closing the "achievement gap" of Mexican Americans: A question of language, learning style, or economics? *Journal of Multilingual and Multicultural Development, 11*(5), 405-417.
Stevensold, 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.
Sticht, T. (1992). *Functional context education: A primer for program providers.* Unpublished document.
Tallmadge, G. K. (1977). *The joint dissemination review panel IDEABOOK.* Washington, DC: National Institute of Education (DHEW).
Ulibarri, D. (1982). *A Neo-Piagetian approach to test bias: Final report.* Washington, DC: National Institute of Education.

Acknowledgments
Funds for the development of this research study were provided by the Research, Scholarship, and Creative Activity Program, and the Affirmative Action Faculty Development Program at San Diego State University.

Keywords
Structural knowledge; Graphic Organizers; Sheltered English; Limited English Proficiency.