UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

THE INFLUENCE OF CONCEPT MAPPING ON ACHIEVEMENT, SELF-REGULATION, AND SELF-EFFICACY IN STUDENTS OF ENGLISH AS A SECOND LANGUAGE

A Dissertation

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

Doctor of Philosophy

By

Pasana Chularut

Norman, Oklahoma

2001

UMI Number: 3004889

THE INFLUENCE OF CONCEPT MAPPING ON ACHIEVEMENT, SELF-REGULATION, AND SELF-EFFICACY IN STUDENTS OF ENGLISH AS A SECOND LANGUAGE

A Dissertation APPROVED FOR THE
DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

BY

Teresa K. DeBacker

Kitsee Patterson

Raymond B. Miller

[illegible]

[illegible]

ACKNOWLEDGMENT

Many different people involved and assisted me during my doctoral studies and so they deserve acknowledgment. This dissertation would never been written without the encouragement and all the help from all my committee members. I first would like to thank Dr. Lotsee Patterson, my outside committee member, for her continuous warm support and encouragement as I moved through my studies. She always smiles and welcomes me whenever I meet her. I see her as my teacher and as a role model who is always energetic.

I would like to thank Dr. Amy Bradshaw for introducing me to "the world of technology" and giving me the opportunity to learn more in this field. She has also been willing to listen whenever I approached her with academic questions or general topics.

I would like to thank Dr. Jason Osborne for expanding my knowledge in multivariate statistics, especially, the knowledge of the statistical tests in behavioral sciences. His guidance was useful and clarified me to the appropriate directions for doing research.

I would like to thank Dr. Raymond Miller for teaching me a great number of learning strategies and the social cognitive theory that were utilized in my dissertation. I owe much of my success for the completion of this program to him because without out his teaching and support, I would not have been able to succeed.

I would also like to express my appreciation to Mark Hamilton, an English teacher, and all ESL students who participated in my study. Without their cooperation this research study would not have been conducted. In addition, I am certainly appreciative for my wonderful friends and colleagues in the department. Too many to name, but they know who they are!

I am forever grateful for having the most kind-hearted, generous, encouraging, loving, and supportive parents. They are a steadfast anchor for me and have always exemplified how great parents should act and react. They have instilled the value of education in me and provided me with educational opportunities, which have made this accomplishment possible.

A great deal of gratitude must also be extended to my former advisor, Dr. Barbara Greene, for always having an open door and taking time to guide and encourage me, and for giving me the opportunity to make my graduate experience meaningful, enjoyable, and fulfilling. I have learned a great deal from her class where I was able to choose the topic of my dissertation. She is truly an inspiration.

Finally, I am deeply indebted to my advisor, Dr. Teresa DeBacker, for her guidance, motivation, and gifted insight, for her careful proofreading of multiple drafts of each chapter, for her criticism and encouragement, and for her patience and all the help she gave me all these years. She was always available at her office so that I was able to reach her whenever I needed her assistance. She truly helped me reach my fullest potential as a graduate student and it is for this that I am most thankful. I have the utmost admiration for her as a teacher, mentor, researcher, and scholar.

Because of the help of these special individuals, my learning goal on becoming a doctor was achievable and now I am able to use my knowledge in the real world with confidence.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

Figure Page

Abstract

This study investigated the effectiveness of concept mapping used as a learning strategy with students in English as a Second Language classrooms. Seventy-nine ESL students participated in the study. Variables of interest in the study were (a) students' achievement when learning from text, (b) students' reports of use of self-regulation strategies (self-monitoring and knowledge acquisition strategies), and (c) students' self-efficacy for learning from text in English. A randomized pretest-posttest control group design with (a) concept mapping group and (b) an alternative learning strategy group was employed. A Split-Plot Analysis of Variance and a Split-Plot Multivariate Analysis of Variance were computed. The findings showed the statistically significant interaction of time and method of instruction for achievement, self-monitoring, knowledge acquisition strategies, and self-efficacy. For all variables, the concept mapping group showed significantly greater gains from pre-test to post-test than the alternative learning strategy group. These findings support the predictions that students in the concept mapping condition would outperform students in the alternative learning strategy condition on achievement, self-monitoring, knowledge acquisition strategies, and self-efficacy. The findings have implications for both practice and research.

CHAPTER ONE

INTRODUCTION

Over the years, educators have sought new ways to help learners to acquire information. Years ago, teaching was considered the act of transferring information from the teacher to the student. The student was relegated to a passive role in the learning experience, becoming an empty vessel that was filled with knowledge. This view of learning was due to the popularity of Behaviorist theories. Behaviorists are not concerned with what occurs inside the heads of students, but focus on how the presentation of information affects the learning outcomes (Weinstein & Mayer, 1986). In contrast, cognitive scientists emphasize the study of how information is processed and stored in memory (Weinstein & Mayer, 1986). Students can now be viewed as information processors who have the ability to use various strategies to store and retrieve knowledge (Weinstein & MacDonald, 1986). Teaching students to use learning strategies often produces positive results. Learning strategy instruction typically is moderately to highly successful, regardless of the strategy or instructional method (Schunk & Rice, 1999).

Park (1995) defines learning strategies as the "mental activities that people use when they study to help themselves acquire, organize, or remember incoming knowledge more efficiently" (p. 35). There are a number of learning strategies that can help students to become more sophisticated, and thus better able to learn and to achieve in the classroom over the long run. These strategies include meaningful learning, organizing, note taking, identifying important information, and summarizing (Pressley, 1982; Weinstein, 1988).

For instance, meaningful learning, according to Ausubel (1963), results when a person consciously and explicitly ties new knowledge to relevant concepts or propositions that she or he already possesses. We learn information meaningfully by storing it in long-term memory in association with similar, related pieces of information. Meaningful learning appears to facilitate both storage and retrieval. The information is encoded more quickly and is remembered more easily (Armbruster & Anderson, 1980).

To learn meaningfully, individuals must choose to relate new knowledge to relevant concepts and propositions that they already know. Rote learning, on the other hand, results when new knowledge is arbitrarily incorporated into the cognitive structure. The individual is able to recall the new information but is unable to apply it in solving new problems (Okebukola, 1990). In rote learning, there is little or no attempt to make the information meaningful or to understand it in terms of things one already knows. Research indicates that concept mapping is an effective learning strategy that precipitates meaningful learning (Williams, 1997; Stewart, Van Kirk, & Rowell, 1979; Moreira, 1979; Novak, 1979; Novak, Gowin, & Johansen, 1983; Malone & Dekkers, 1984; Ault, 1985; Fraser & Edwards, 1987; Feldsine, 1987; Barenholz & Tamir, 1987).

According to Novak (1981), concept mapping is a tool for representing the interrelationships among concepts in an integrated, hierarchical manner. Concept maps depict the structure of knowledge in propositional statements that dictate the relationships among the concepts in a map. Connected by labeled lines, the concepts depicted in concept maps have superordinate-subordinate relationships as well as interrelationships. Similarly, Jonassen, Yacci, and Beissner (1993) viewed concept maps as two-dimensional, dynamic diagrams that illustrate relations among ideas in a content area. They are spatially organized with keywords linked by labels identifying the type of relations among the concepts/ideas. These diagrams allow students to map their understanding of a particular content area. Heinze-Fry and Novak (1990) state that meaningful learning is facilitated because concepts are seen not as isolated entities but as existing in a network of relationships. Links not only connect adjacent concepts but often connect concepts in different sections of the concept map. The resulting web of concepts increases the number of relationships that connect new information to existing concepts, thereby increasing the stability of the new information.

Concept maps have been used successfully in many different disciplines, and with students from elementary school to graduate school (Heinze-Fry & Novak, 1990; Novak, Gowin, & Johansen, 1983; Starr & Krajcik, 1990; Willerman & Mac Harg, 1991; Beyerbach & Smith, 1990; Okebukola, Alaiyemola & Jegede, 1990; Okebukola, 1990; Okebukola & Jegede, 1989; Pankratius, 1990; Wallace & Mintzes, 1990). They can also be used with students who differ in intellectual ability (Malone & Dekkers, 1984).

Students can benefit in numerous ways from constructing their own concept maps for classroom material (Novak & Gowin, 1984). Beside the learning benefits of concept mapping training, instruction in how to use concept mapping could also foster self-regulation and self-efficacy. Self-regulation refers to the degree that individuals become metacognitively, motivationally, and behaviorally active participants in their own learning processes (Zimmerman, 1986). Effective learners, through self-regulation, become aware of functional relations between their pattern of thought and action and social and environmental outcomes (Zimmerman & Martinez-Pons, 1988). Such students personally initiate and direct their own efforts to acquire knowledge and skill rather than relying on teachers, parents, or other agents of instruction (Zimmerman & Schunk, 1989).

As Zimmerman (1989), Schunk (1991), and others have discussed, students who are self-regulated are more likely to use effective learning strategies, to be meaningfully engaged in their own learning, and to attain their academic goals.

According to Zimmerman (1989), people's knowledge of their own learning and cognitive processes, and their consequent regulation of those processes to enhance learning and memory, are collectively known as metacognition. The concept of metacognition initially emerged within the context of information processing theory. It is also consistent with social learning theorists' notion of self-regulation. Metacognition provides the mechanism through which children begin to regulate one aspect of their lives—their own learning (Zimmerman, 1989). Metacognition includes knowledge and skills such as being aware of one's own learning and memory capabilities and of what learning tasks can realistically be accomplished, knowing which learning strategies are effective and which are not, and planning an approach to a learning task that is likely to be successful and knowing effective strategies for retrieval of previously stored information.

Engaging in concept mapping activities may contribute to self-regulation through its influence on self-observation, one of the four components of self-regulation identified by Bandura (1986). Self-observation (or self-monitoring) may be used during concept mapping, encouraging the students to be "observers" of their own learning. Knowledge acquisition strategies may also be affected in that concept mapping may assist the students to acquire knowledge by depicting the relationships among ideas/concepts. Therefore, the self-regulated learning strategies that were examined in the current study were self-monitoring and knowledge acquisition strategies because these were the aspects of self-regulation that were expected to be the most influenced by students' learning to use concept maps.

The theoretical framework of this study is social cognitive theory, which views self-regulation as entailing at least four components: goal setting, self-observation, self-judgment, and self-reaction (Bandura, 1986; Schunk, 1989). The first component is goal setting. Self-regulated learning processes involve goal-directed cognitive activities that students instigate, modify, and sustain (Zimmerman, 1986). Goals provide standards against which people compare their present performances (Bandura, 1986).

The other three components of self-regulation (self-observation, self-judgment, and self-reaction) are not mutually exclusive but, rather, interact with one another (Bandura, 1986). The first of these is the act of self-observation. Self-observation lets the student know if the proper performance is achieved, and if not, what needs to be done to accomplish the behavior (Schunk, 1990). During work on concept maps, the students will notice; (a) whether their concept map is developing in the right direction and (b) whether their concept map construction is progressing toward their goals. Construction of the map necessitates not only understanding the terms/concepts, but also reflection on how well a particular arrangement of terms illustrates or explains the concept. By examining concept maps the students themselves have constructed, any misconceptions and "holes" in learners' understanding become readily apparent (Novak & Gowin, 1984).

Another component of self-regulation is self-judgement. Self-judgement, like self-observation, can serve as a point of reference from which to continue to accomplish the goal (Bandura, 1986). In concept mapping training, after self-observation, the students will begin to judge and evaluate their own concept maps based on the standards or the goals they hold for themselves. If their performance is progressing toward their goals, the students will continue to complete their concept maps. In contrast, if there is some process of revision, the students will make a revision on their concept maps.

Following self-judgment, the self-reaction component plays an important role in the self-regulation process (Bandura, 1986). During this part of regulation, the student either feels satisfied/gratified with an appropriate arrangement or dissatisfied with the arrangement. Students who judge their learning progress as inadequate may react by seeking further information or asking for assistance. On the other hand, the students who feel satisfied/gratified with their concept maps may be motivated to use concept mapping as a learning strategy in other classes. Schunk (1994) noted that the belief that one is making progress, along with the anticipated satisfaction of goal accomplishment, enhances self-efficacy and sustains motivation. Thus, it is reasonable to conclude that self-regulation may be an inherent part of the use of concept mapping. Requiring students to use concept mapping may therefore increase their subsequent use of self-regulation (self-monitoring and knowledge acquisition strategies) in learning. Furthermore, engaging in concept mapping may increase the student's self-efficacy, which is influenced by self-regulatory processes.

Self-efficacy refers to personal beliefs about one's capabilities to learn or perform skills at designated levels (Bandura, 1986, 1989; Schunk, 1991). If students are usually successful at school activities, they come to believe that they have high ability; in other words, they develop a high sense of self-efficacy for academic tasks. On the other hand, if students experience frequent failure in their schoolwork, and especially if they attribute this failure to low ability rather than to lack of effort or poor study strategies, they may develop low self-efficacy concerning their competence in academic subjects (Schunk, 1985).

Strategy instruction is an effective means of promoting self-regulated learning and perceived efficacy (Carno & Mandinach, 1983; Schunk, 1986). Strategies help students attend to tasks, focus on important features, organize material, and maintain a productive psychological climate for learning (Weinstein & Mayer, 1986). Self-regulated learners apply strategies and understand how strategies improve their performance (Pintrich & De Groot, 1990; Zimmerman & Martinez-Pons, 1992).

In the current study, it was hypothesized that self-efficacy will be influenced by the self-regulation process during concept mapping training. It is assumed that students enter the mapping activities with the goal of illustrating interrelationships among concepts on the map. This proximal and challenging goal will organize students' efforts as they complete their concept maps. As the students work on their concept maps, they may use self-regulatory strategies (self-monitoring, knowledge acquisition strategies) to help them to draw concept maps and to learn the information from the passage. The students will know which parts of their concept maps are working well and which parts need improvement. Engaging in these activities, the students' understanding or any misconceptions from the passage may become clearly apparent. Finally, as students gain proficiency in reading the passage, they will perceive that they are making progress toward their goals and becoming more competent. Furthermore, students' self-efficacy about their learning from text may be improved. Concept mapping strategy, self-regulation, and self-efficacy are believed to interact with one another in that concept mapping is a learning strategy that could foster self-regulation, and then self-efficacy is further influenced by the self-regulation process.

The purpose of the current study was to investigate the use of concept mapping as a learning strategy with students in English as a Second Language (ESL) classrooms. Generally, the ESL students who just came to the U.S.A. and study at the Center for English as a Second Language are considered poor English readers. They might have a limited vocabulary in English. They might not know how to learn meaningfully, especially in English. In addition, the ESL students may have little experience in using learning strategies for assisting them in learning from text in English and therefore will benefit from the concept mapping training. If concept mapping has been used successfully with first language learners, it may be a useful tool for ESL learners as well, especially in assisting their understanding of their reading tasks. Therefore, the students' learning from text was examined in this study. It was also hypothesized that requiring students to use the concept mapping strategy may increase their subsequent use of self-regulation (self-monitoring and knowledge acquisition strategies) in learning and that self-efficacy may be enhanced by the self-regulation processes. Thus, the self-regulated learning strategies that were examined in the current study were self-monitoring and knowledge acquisition strategies. This study also examined whether a concept mapping strategy could foster students' self-efficacy. Specifically, this study sought to answer the questions: (1) Do ESL students in a concept mapping group show greater achievement than students in an alternative learning strategy group? (2) Do ESL students in a concept mapping group show greater self-regulation of learning (monitoring and knowledge acquisition strategies) than students in an alternative learning strategy group? (3) Do ESL students in a concept mapping group show greater self-efficacy than students in an alternative learning strategy group?

This study took place during the second seven-week session of the fall semester within the context of reading in English as a second language at the Center of English as a Second Language at the University of Oklahoma during fall semester of 2000. The remainder of this document begins with the theoretical foundations of concept mapping strategy. Following the theoretical section, the research literature on concept mapping training is reviewed. In the next two major sections of Chapter Two, research on the social cognitive theory of self-regulation and on self-efficacy theory, is also reviewed. In Chapter Three the methodology is described. In Chapter Four and Chapter Five, the results and a discussion of the findings, with subsections offering ideas for practice and future research is presented.

Definition of Terms

Definitions of key terms for the purposes of this study are:

1. **Concept mapping:** is a technique that conveys the meaning of important relationships in text by representing them in an interconnected diagram. The particular content selected for mapping can vary according to the reader's purpose, prior knowledge, perspective, and interest.
2. **A concept map:** is a graphic arrangement of the key concepts in a body of subject matter with connecting lines labelled to show valid and meaningful relationships between the chosen concepts.
3. **Meaningful learning:** provides evidence that the individual has been able to internalize a new stimulus and it is reflected in the ability to apply the new knowledge to other situations. In this study, data on meaningful leaning is collected from the student's achievement test.
4. **Self-regulation:** In this study, self-regulation involves the students' self-monitoring and knowledge acquisition strategies. This will show the extent to which students can use the strategies for studying, how well they can understand the concepts they are studying, and how often they will check and correct their understanding of these concepts.
5. **Self-efficacy:** the students' perception of their effectiveness and abilities to read the reading passages and to do the assignments in ESL class.

CHAPTER TWO

REVIEW OF THE LITERATURE

Theoretical Foundations

Learning Strategies

Academic achievement is strongly linked to the successful adoption of appropriate learning strategies by the learner (Zimmerman, 1990; Zimmerman & Martinez-Pons, 1986; Bandura, 1982; Schunk, 1984, 1993). Learning strategies are the purposeful actions and thoughts that learners engage in when they want to understand, store, and remember new information and skills. The defining characteristic of good learners and expert performers in any field is the ability to select appropriate strategies and to deploy them efficiently. Learning strategies can be classified as metacognitive strategies, cognitive strategies, and social and affective strategies (Doring, Bingham, & Bramwell-Vial, 1997).

Metacognitive Strategies. Metacognition means thinking about the learners' own thinking and learning processes. When they take time to plan how they'll go about a task, they are using a variety of metacognitive strategies. Similarly, when they surface from task engagement from time to time to check on our progress, they are also engaged in a metacognitive strategy. After they have finished a task---whether it's writing a paper or teaching a lesson ---they can sit back and thoughtfully evaluate their own performance. This self-evaluation is also a metacognitive strategy. When the learners use metacognitive strategies they have powerful tools for regulating their own learning and performance (Doring, et al., 1997).

Cognitive Strategies. These are the strategies that the learners can use to accomplish a task. For example, if the learners want to remember an informative lecture, they might take notes. If they encounter an unfamiliar word while reading, they may look at the surrounding context to make an inference about its meaning. If they cannot immediately remember a word or phrase they want to say or to write, they may substitute a synonym or paraphrase. One cognitive strategy that good learners consistently use is elaboration of prior knowledge. When learners can tie in something new to an existing schema or knowledge framework, they understand it better and retain it longer. So cognitive strategies involve working directly with the material they want to learn, often transforming it in some way to make it ours (Doring, et al., 1997).

Social and Affective Strategies. As the name implies, these are strategies that involve interaction with another person and that influence our affective state. For example, when a team of teachers work to develop a curriculum guide, they are using the strategy of cooperation because they know that the interaction of ideas and expertise will result in a better product. Similarly, they ask questions for clarification when they need to understand the requirements of a task or to make sure that they have understood what another person has said (Doring, et al., 1997).

According to Doring, et al (1997), concept mapping may be considered as a cognitive strategy where students can tie in something new to an existing schema or knowledge framework that fosters meaningful learning. However, most studies used concept mapping as a metacognitive strategy (Novak, 1987; Kim, German, & Patton, 1998; Okebukola & Jegede, 1989; Okebukola, Alaiyemola & Jegede, 1990). For instance, Novak (1987) indicated that concept mapping is a metacognitive strategy because it assists learners in understanding concepts and relationships among these concepts and in seeing the hierarchical, conceptual, and propositional nature of knowledge. Kim, German, and Patton (1998) also reported that concept mapping can be an effective metacognitive tool in facilitating one's construction of knowledge. In the current study, concept mapping is considered as a metacognitive strategy.

The foundational work in concept mapping was pioneered by Joseph Novak. Novak, Gowin, and Johansen (1983) stated that their early work on concept mapping focused on Ausubel's (1978) Assimilation theory. Of particular interest to Novak and his colleagues was the role of prior knowledge in learning and the difference between rote and meaningful learning. From this research Novak and his colleagues developed the technique of concept mapping (Douglas, 1997).

Concepts. The term "concept" is used in many ways in educational and psychological literature. Some definitions focus on common attributes of objects or events which result in their belonging to the same category, and the labeling of that category with a word (Frayer, Fredrick & Klausmeier, 1969; Lloyd, 1990). Other discussions focus on the network of relationships among concepts (Anderson, 1980; Novak & Gowin, 1984). Novak (1977) defines concepts as "inventions of man used to describe observed regularities in events" (p. 87). Novak goes on to say that to learn a concept the learner must see the meaning in the regularity of the events. As he/she goes through life, concepts are acquired. A young child gains concepts through experience and interaction with the world. New concepts can be understood using concepts that already exist in the child's cognitive structure. Concepts may occur at different levels of generality, one subsuming the other, and thus be represented by hierarchical relationships

(Novak, 1984; Novak & Gowin, 1984). These hierarchical relationships have been depicted in various ways. Most notable in the literature of science education is the use of concept maps (Novak & Gowin, 1984). Concept maps show the hierarchical relationships of ideas by graphically depicting levels of concepts. Concept maps also show the nature of the relationships between ideas through the use of linking words that connect the concepts. It is also true that knowledge domains are organized on concepts. Novak (1976) argues that since science is an evolving body of concepts, science teaching should be based on concept learning. Since human thinking is oriented to concepts and the knowledge that is taught in schools is concept oriented, then education should utilize tools that take advantage of concept-based learning and conceptual understanding.

Meaningful Learning. The central concept of Ausubel's assimilation theory is the concept of meaningful learning. Meaningful learning occurs when new knowledge is related to existing concepts in the learner's cognitive structure (Ausubel, 1978). In Ausubel's theory, meaningful learning consists of a number of processes: subsumption, progressive differentiation, obliterative subsumption, superordinate learning, and integrative reconciliation. As new information is added to the learner's cognitive structure, the result is a cognitive structure that is qualitatively different. The process of linking new information to existing concepts is the process of subsumption. In subsumption, a new concept is linked below a more general concept in a hierarchical manner. The more general concept under which the new concept is linked is called the subsumer. As learner continues to learn new information, concepts become more elaborated and differentiated. This process of on-going elaboration and differentiation of concepts is called progressive differentiation. Learners with thorough conceptual understanding of a topic would have an extremely elaborated and differentiated cognitive structure (Ausubel, 1978).

But over time learners tend to lose the details of concepts. This process of forgetting is called obliterative subsumption. As time passes, concepts lower in the hierarchy become indistinguishable from their parent concepts. Ausubel (1978) asserts that the details are lost but the concept remains with the resulting growth. The concept is still able to facilitate meaningful learning. In the learner's cognitive structure a number of concepts may exist. The process of reconciling newly learned concepts with misconceptions is called integrative reconciliation. The process is particularly important in science learning. As children encounter their environment, numerous misconceptions result from day to day experience. When these misconceptions are challenged with scientific fact, the result is integrative reconciliation.

On the opposite end of the continuum of meaningful learning is rote learning. Ausubel (1978) defines rotely learned information as isolated concepts that are related to the cognitive structure in some arbitrary way. Rotely learned material is more easily forgotten since it lacks linkages to existing concepts. Since rote learning creates concepts that are isolated, each rote learning task is a separate endeavor where the material must be learned from the ground up. In contrast, meaningful learning builds on existing knowledge structures. Hence, meaningful learning is influenced by the extent of the prior knowledge that the learner posses. When learning new material in a meaningful manner, the new knowledge is integrated into the cognitive structure. Ausubel (1978) states that prior knowledge is the major factor affecting meaningful learning and retention.

Assimilation of new knowledge into learner's cognitive structure is dependent on the concepts that already exist in that structure.

The Concept Map

A concept map is a graphic arrangement of the key concepts in a body of subject matter with connecting lines labeled to show valid and meaningful relationships between the chosen concepts (Novak & Gowin, 1984). Each concept map represents a personal expression of meaning in the selected material and, as such, concept mapping is an idiosyncratic learning and working strategy which serves to satisfy a mapper's particular approach to understanding a body of selected material (Rafferty & Fleschner, 1993). Typically, a concept map is comprised of a number of selected key concepts, one of which is identified as the focal concept on the map. The selected concepts are linked by lines with arrows and labeled to stipulate meaningful relationships between them.

A focal concept is a concept that is of special interest to a mapper and is the focus of the particular map. On a page the focal concept can be placed at its center, at one side, at the top or at the bottom. Usually, the focal concept is chosen from the most general concepts in the selected material. However, the choice of a focal concept is a personal decision and a number of mappers of the same material are quite likely to differ in their choice of focal concepts.

The steps in concept mapping as elucidated by Novak and Gowin (1984) are:

1. Identify the key concepts, events, and objects in the material that is to be mapped. This requires careful reading of the selected material and separating the key concepts, events, and objects from the rest of the text.
2. Select a focal concept from the list of key concepts and cluster the concepts

according to the extent to which they closely interrelate. There are no fixed rules for selecting a focal concept.

3. Arrange and link the focal concept and clusters of related concepts with lines from the most abstract and inclusive to the most concrete and specific. The use of arrows will help draw out the focal concept from the related concepts and communicate the arrangement of the concepts more effectively.
4. Label the connecting lines on a map to show valid and meaningful relationships between the concepts. Work with one pair of concepts at a time. Once linkages are labeled, a concept map should be readable in the direction of the arrows.

Review of Concept-Mapping Research

Influence of Concept Mapping on Meaningful Learning

Concept mapping has been determined to promote meaningful learning (Okebukola, 1990; Okebukola & Jegede, 1988; Heinze-Fry & Novak, 1990; Stice & Alvarez, 1987; Edmondson & Smith, 1996). Creating concept maps encourages the learner to link together concepts in meaningful ways (Douglas, 1997).

Okebukola (1990) conducted a study that provided support for the potency of the concept mapping technique in bringing about the learning of genetics and ecology in a meaningful manner. One hundred thirty-eight college students were randomly assigned to the experimental group and to the control group. The Test of Meaningful Learning in Genetics and the Test of Meaningful Learning in Ecology were used. Each test had 40 multiple-choice items at the comprehension level and beyond. The students in the experimental group had two one-hour lessons and two one-hour practice sessions on concept mapping. In subsequent lessons, the students were required to prepare and hand in concept maps on the topic for discussion for every lesson. After attaining a good degree of fluency in concept mapping, the experimental group students took the test of meaningful learning in genetics as a pre-test. The control group students also took this test. Then, in the three-week treatment following the pretest, the experimental group received instruction in genetics using the concept mapping strategy. At the end of three weeks, the students were asked to prepare a summary concept map from all the concepts taught to them during the period of instruction in genetics. In the control class, the students were taught the same topics in genetics as the experimental class. After three weeks, both groups took the Test of Meaningful Learning in Genetics as a post-test (Okebukola, 1990).

Ecology happened to be the next aspect of biology studied after genetics. The methods of instruction, described above for both experimental and control classes were followed. The results showed that the students in the experimental group who employed the concept-mapping strategy performed significantly better on the test of meaningful learning in genetics and ecology than their control group counterparts (Okebukola, 1990).

The research described by Heinze-Fry and Novak (1990) also provided some evidence for the use of concept mapping as a tool to enhance meaningful learning in college autotutorial biology students. In this study, concept mapping was introduced to a group of twenty students who volunteered to try out a new learning strategy. They made individual maps and received feedback on their maps for three instructional units. This phase of the program ran about one month. As a control group, twenty more volunteers agreed to use their usual learning strategies. Students were administered a multiple-choice test as a pretest- and as a posttest. Both the experimental group and the control group also participated in an interview session in which they wrote all they knew about each of several topics. For the experimental group, the final constructed map was evaluated for number of linkages, number of levels of hierarchy, and number of cross-links. All terms were added together to get a final interview score. After four weeks of intervention, the posttest and interviews were conducted immediately and again, five months later.

Heinze-Fry and Novak (1990) did not find any statistically detectable results but reported several tendencies. Scores on the multiple-choice posttest and interviews tended to be higher for the mapping group. They also found that this gap increased on a delayed posttest administered five months later. In support of concept mapping, the researchers reported that, compared to students in the mapping condition, students in the control condition made more errors on the initial (immediately after completing the third unit) and the delayed (five months later) post-test interventions, and made fewer links among concepts in their descriptions of the curriculum. Students who used concept mapping reported that it affected their learning style by increasing integration, organization, understanding, and retention. They also reported having to study less for the final examination (Heinze-Fry & Novak, 1990).

In addition, a study by Okebukola and Jegede (1988) investigated the effectiveness of concept mapping as a learning strategy, as well as cognitive preference and learning mode as determinants of meaningful learning. Participants consisted of 145 college students. Cognitive preference data was collected with the Biology Cognitive Preference Inventory (BCPI). Each item provides a piece of information and four extension statements in the form of options corresponding to the four cognitive preference areas. These were: recall, principles, questioning, and application. The learning modes were cooperative and individualistic. Meaningful learning was measured using a 40-item teacher-made test containing items at the comprehension and higher levels of Bloom's taxonomy.

A pretest-posttest experiment with non-random assignment of participants to experimental and control groups was employed in this study. In the first phase of the study, experimental group participants were taught biology using the concept mapping technique. Control group participants had instruction through lectures in an expository manner. After the first three weeks of lectures at a weekly rate of four one-hour periods, the students in the experimental group attained a good measure of fluency in the concept mapping procedure. Regarded as the second phase of the study, experimental and control group students were administered the achievement test as a pretest. The experimental participants also took BCPI. In the experimental condition, participants were asked to indicate their preference for cooperative and individual work.

During the treatment period of the study, both experimental and control group participants had instruction on the same topics for three weeks. In the experimental group, students worked cooperatively on the concept map exercises during each lesson or individually. The concept mapping strategy was not used in the control class. At the end of the treatment period, experimental participants were then asked to individually construct the concept map based on class discussions during this review exercise. All participants in the experimental and control conditions took the achievement test immediately after this as a posttest.

The results of this study indicated that concept mapping is an effective learning strategy (Okebukola & Jegede, 1988). In both the cooperative and the individualistic conditions, participants with a preference for Principles had the highest mean score on the measure of meaningful learning and in performance in making concept maps. Students with a preference for Recall had the lowest mean score on the two measures. Furthermore, students working together cooperatively on the concept mapping tasks were found to attain meaningful learning better than students working individually.

Edmondson and Smith (1996) described the successful application of concept mapping to the development of an integrated, interdisciplinary veterinary curriculum, in the development of case-based exercises for problem-based learning, and as a learning tool by students, working individually or in small groups. The authors reported that the use of concept maps to this extent was well received by students. The vast majority claimed that concept maps greatly facilitated their understanding of the relevant pathophysiologic mechanisms contributing to an acid/base disturbance or to fluid disorder. Additionally, responses from the faculty involved with the course were also very positive. The authors argued for the need to help students integrate their learning, and for the value of concept maps in helping to make conceptual relationships explicit, in identifying errors and omissions, and to reveal misconceptions in the students' understanding (Edmondson & Smith, 1996).

Although all previous research involved college students, Stice and Alvarez (1987) chose to assess the potential of concept mapping as a learning strategy with kindergarten through fifth graders. Nine classroom teachers and their students participated in this study. Each classroom contained an average of 29 children. First, the teachers were instructed in the terminology of the concept map using Gowin's (1981) terminology (Gowin, 1981 as cited in Stice & Alvarez, 1987) and then were asked to employ the steps from Novak and Gowin (1984) in generating the initial concept maps with the children. For instance, in the beginning, "have the children close their eyes and ask them if they see a picture in their mind when you say a familiar word (e.g., dog, chair, grass) and use object words at first. Then, print each word on the board as the children respond and ask the children for more examples and so on."

During the four months of the study, the children demonstrated their understanding of concepts by developing concept maps. The authors report the following observations. For the first grade, children's concept maps became increasingly detailed and accurate as teachers helped clear up misinformation and as the children learned. For the second grade, the children seemed to appreciate more fully the need to brainstorm lists prior to mapping. In both the third and some of the second grade classes, children reported that mapping helped them clarify and understand. The mere fact that they kept doing it seemed significant. In fourth grade classes, the children did not seem to want to experiment with mapping as much as the younger children. However, the teacher reported improvement in the children's general learning. The fifth graders produced excellent maps. The fifth grade teacher reported that many of the children who never freely participate in anything seemed to enjoy concept mapping and asked to be allowed to do it. According to the classroom teachers, the children's chapter tests improved, their participation in class discussion was much better, and they appeared enthusiastic about class as a direct result of mapping activities. Finally, the authors concluded that as the children generated their own schema, three major phenomena became apparent: (a) concept maps provide excellent opportunities for further direct instruction, (b) concept mapping appears to be developmental and (c) concept maps can be constructed by very young learners (Stice & Alvarez, 1987).

Several implications can be drawn from the findings reviewed in this section. Findings from these five studies provide evidence that concept mapping helps students in the meaningful learning of concepts. The students who employ meaningful learning are expected to retain knowledge over an extensive time span and find new, related learning progressively easier. Concept mapping helped students to make sense of the material. To a lesser degree, concept mapping helped students learn how they learned, and clarified connections between concepts by putting them on paper (Stice & Alvarez, 1987).

Influence of Concept Mapping on Reading Comprehension, Writing Skills, and Recall

According to Weinstein and Mayer (1986), concept mapping or networking could be considered among the organizational strategies for complex learning tasks. Training students in the use of mapping would help them to organize the information included in materials to be read or studied. Teachers can use concept maps to relate what students know to what they are about to learn. Chaffee (1985) advocated the use of mapping as a way of representing and organizing relations among concepts in reading material. He emphasized that concept maps can be used to represent a number of different relationships among a set of concepts in a single pattern. Further, the organization of the map can be revised to accommodate new information as it becomes available.

Several investigators have reported that mapping facilitates comprehension of text passages (Peresich, Meadows, & Sinatra, 1990; Sheldon, 1984; Reutzel, 1985). Peresich, et al., (1990) investigated the effects on rural high school students in Mississippi of training in concept mapping as a way to improve the students' reading comprehension and writing skills. For the successful implementation of mapping in the classroom, classroom teachers were first trained in the use of mapping. Then, they provided students with maps to show students the way in which the ideas in the passage could be connected. After this preliminary step, teachers assigned a reading selection to the students who, after the reading was completed, were faced with blank maps. Students were guided in the use of mapping by the teacher, who had students either focus on the main idea first, or complete one of the sections of the map. After the teachers provided the students with this model, the students were asked to use mapping in a more open way. The implementation of mapping, according to Peresich, Meadows, and Sinatra (1990) resulted in a dramatic increase of scores for those students who had to take the Basic Skills Assessment required by the state of Mississippi.

A similar type of study was conducted by Sheldon (1984). She compared the effects of training nine-year old students to understand a reading passage by using concept mapping and by answering multiple-choice questions. The study concluded that the students trained in concept mapping made considerable reading gains over those who had received training through questions and answers. Additionally, Sheldon (1984) found that being trained in concept mapping considerably enhanced poor readers' scores. This study has important implications because it suggests that children who are trained to use mapping strategies employ additional procedures for extracting meaning and develop more flexible reading strategies.

Several additional studies (Armbruster & Anderson, 1980; Ruddell & Boyle, 1989; Briscoe & LaMaster, 1991) supported the contention that the process of concept mapping is likely to facilitate comprehension and recall, since concept mapping requires semantic involvement with the text, attention to text structure, and the transformation of prose into a diagrammatic representation.

Armbruster and Anderson (1980) investigated the effectiveness of concept mapping with middle school students. Eleven eighth graders were taught six of the concept mapping relationships during approximately 12 hours of instruction. The instructional strategy was to introduce the relationships one at a time in the following order: Example, Property, Definitions, Compare-Contrast, Temporal, and Causal. After several relationships had been introduced, the students were also given discrimination exercises in which they had to decide which of the relationships was salient before attempting to map the passage. The students worked individually, in pairs, and in small groups. The control group consisted of 43 eighth graders. The passages used for the pre-tests and post-tests were selected from fifth and sixth grade basal readers (Armbruster & Anderson, 1980).

In Armbruster and Anderson's (1980) study, the participants who mapped two passages recalled a greater proportion of idea units than did the control participants, who used their own preferred reading strategy. The differences in recall were statistically significant for the 24-hour delayed recall following one passage, and approached significance for the immediate recall following the second passage. For both passages, the probability of recalling mapped idea units was significantly greater than the probability of recalling unmapped idea units. These results suggest that concept mapping may help student's process text in a way that facilitates recall (Armbruster & Anderson, 1980). It is possible that concept mapping forces the students to analyze a text into its simpler component ideas and relationships. These ideas and relationships then have a greater likelihood of being meaningfully processed and retrieved (Armbruster & Anderson, 1980).

Instead of recall, Ruddell and Boyle (1989) examined the effects of concept mapping on written summarization and comprehension of expository text. Fifty-one freshmen college students participated in the study. The experimental intervention for concept mapping involved a total of three hours of direct instruction in using the strategy and six weeks of practice in concept mapping for homework. In the control group, these students were taught the organization strategy of constructing topic outlines during the three hours of direct instruction and related homework.

The findings revealed that the concept mapping treatment groups scored significantly better on holistic scores, based on written summarizations of thesis-proof and problem-solution articles. The concept mapping treatment students also identified more details, which were used to support main ideas than did the control group students. Moreover, the concept mapping treatment groups used significantly more cohesive tie-ins in writing their summarizations than did the control group. Additionally, concept mapping students wrote longer and better organized summarizations using the concept mapping procedure (Ruddell & Boyle, 1989). These findings are consistent with Briscoe and LaMaster (1991) in that concept mapping was useful when the students were reading more difficult material or reading information that required "more thinking." All of the students claimed that concept mapping helped them to identify concepts they should link with others, even when they were unable to articulate the nature of those links. The students also reported being better at recognizing what they did not know and remedying that gap (Briscoe & LaMaster, 1991).

Influence of Mapping Strategies on Reading Comprehension of ESL Students

Based on a review of the literature, the concept mapping strategy is one of many learning strategies that have been used successfully in the English as a Second Language (ELS) classroom. However, when studies involve reading comprehension in the ESL classroom, some researchers used semantic mapping strategy instead of using concept mapping (Kaufman, 1992; Carrell, Pharis, & Liberto, 1989).

According to Antonacci (1991), semantic maps use categorization of concepts and representation of these concept classifications in a graphical format to convey hierarchical relationships between concepts. The semantic mapping technique was created as a means of increasing learners' vocabulary, thereby enhancing reading comprehension. With semantic maps, new concepts are related to students' prior knowledge and experiences to increase their understanding of the new words. Semantic mapping is often used as a classroom teaching strategy in which students' discussion is used to generate a map of the hierarchical relationships between words. Through these discussions, students are able to link the new concepts to their prior knowledge, thus increasing the meaningfulness of learning (Antonacci, 1991). Semantic mapping uses "chunking" or grouping of similar words in order to improve learning of word meanings. Semantic mapping also uses learners' prior knowledge as a basis for learning new vocabulary and increasing reading comprehension. According to Novak and Gowin (1984), learning is enhanced when learners are able to related new learning to prior knowledge. Learners are encouraged to use prior experience to identify words that are related to the main idea when creating a semantic map (Miller & Perkins, 1989). Remembering words from prior experience activates relevant schemata, which provide a framework for understanding the meaning of the text passage.

Semantic mapping can be used before or after reading a passage with new vocabulary words. As a pre-reading strategy, semantic mapping serves readers as a tool to activate their prior knowledge before reading (Hanf, 1971). Teachers may use it as an assessment tool to determine how much prior knowledge student possesses about the content they are to read (Antonacci, 1988 as cited in Antonacci, 1991). Finally, for students with information gaps, the mapping procedure serves to develop students' prerequisite knowledge before they engage in reading the textbook. As a post-reading strategy, semantic mapping is an effective technique because it provides the students with a tool to recall, organize, and represent visually the "new" information and to integrate it with what they already know, the "old" information (Antonacci, 1988 as cited in Antonacci, 1991).

The procedures for developing semantic maps as elucidated by Antonacci (Antonacci, 1988 as cited in Antonacci, 1991) are:

1. Select the topic to be mapped, and write it on the center of a chalkboard or paper.
2. Identify concepts related to this main idea, and write them on the board (or paper). If drawing a semantic map as part of a classroom activity, have students participate in the identification of related concepts in a brainstorming session.
3. Group related words into categories.

4. Name the categories of related concepts. Again, if map construction is part of a classroom activity, have students generate the titles for each of the groups of related words.

There is evidence that semantic mapping can be used as a technique to improve reading comprehension in ESL classrooms (Carrell, et al., 1989; Salam & Koumy 1999). For instance, Carrell, Pharis and Liberto (1989) showed that strategy training with semantic mapping and with the ETR (experience, text, relationship) method improved reading comprehension scores. This study specifically examined whether strategy training enhances L2 (second language) reading. The study involved a heterogeneous group of 26 ESL students in a level 4 intensive ESL program at a university. Two experimental groups were formed, one which received the semantic mapping training and one which received the ETR training. A control group simply received the pretest and posttest. During a four-day training session, the first group was given a series of reading passages. Questions were used to stimulate discussion and semantic maps were created. The ETR group received the same passage, however, group activities included note-taking, discussion, comprehension questions, and vocabulary activities that related to the texts. Participants received a pretest before the onset of training and a posttest nine days after training. The tests included questions in varied formats and two out of three passages on the test required the subjects to complete semantic maps.

The results indicated that each training group showed significant gain scores on the open-ended questions. The control group did not have significant gains scores between their pretests and posttests on any of four dependent measures which were multiple-choice questions, open-ended questions, cloze semantic mapping, and open-ended semantic mapping questions (Carrell, et al., 1989).

A similar study was conducted by Salam and Koumy (1999). This study compared the effectiveness of three classroom methods for teaching semantic mapping to college-level learners of English as a Second Language. The participants were 187 freshmen at an Egyptian university randomly assigned to three treatment groups. These were teacher-directed semantic mapping, student-mediated semantic mapping, and teacher-student interactive semantic mapping. The treatment was administered over five months in one session per week. The participants were pretested and posttested in reading comprehension. The results showed that the teacher-student interactive semantic mapping group scored significantly better on reading comprehension than the other two groups, which had similar results (Salam & Koumy, 1999).

Semantic maps appear to be most appropriate for tasks that involve learning or classifying concepts. When drawing semantic maps, learners must be able to classify concepts according to key characteristics in order to group words into the categories displayed on the map. However, only hierarchical relationships between ideas are conveyed on a semantic map. While more complex relationships may be identified in the process of creating the semantic map, these relationships are not depicted on the map itself. Also, the interrelationships between coordinate concepts are not made explicit on the semantic map.

Although semantic mapping has been used in an English as a Second Language classrooms, the current study will use concept mapping to assist ESL students in learning from text. Concept mapping is a strategy that conveys the meaning of important relationships in text by representing them in an interconnected diagram (Armbruster & Anderson, 1980). Concept words are linked by lines that are labeled to identify the type of relationship among the concepts. Although organized primarily in a hierarchical fashion, multiple linkages between concepts can be identified on the maps by using multiple labeled lines to depict how each concept is related to many other concepts (Heinze-Fry & Novak, 1990).

In addition, according to Novak and Gowin (1984), concept maps can be useful not only for understanding typical school textbooks but also for better understanding of literary works such as novels. They also have found concept mapping to be a good "shorthand" for taking notes on papers or articles in newspapers, magazines, and technical journals. "After a quick reading of an article, it is relatively easy to go back and circle key concepts or propositions and then to construct a concept map representing them in a hierarchical order" (p.49).

In conclusion, there are two differences between semantic maps and concept maps. First, concept maps are more complex and inclusive of relationships. Interrelationships between coordinate concepts are explicit on the concept maps. Semantic maps use chunking or grouping of similar words in order to improve learning of word meanings. Therefore, semantic maps display only hierarchical relationships between ideas but causal relationships are not explicit on the maps. Second, concept maps focus on meaningful learning of subject matter whereas semantic maps focus on learning language, specifically on increasing learners' vocabulary. According to the characteristics of concept mapping strategy, concept mapping strategy is expected to be more effective in assisting ESL students in their reading tasks than semantic mapping strategy.

Summary

One of the common features across these research studies is that concept maps often facilitate students' learning outcomes. Most of these studies have focused on the use of concept mapping as a learning strategy in promoting meaningful learning in a variety of knowledge domains and instructional settings (Okebukola, 1990; Okebukola & Jegede, 1988; Heinze-Fry & Novak, 1990; Stice & Alvarez, 1987). The use of concept mapping strategies also enhances students' reading comprehension and writing performance (Weinstein & Mayer, 1986; Peresich, et al., 1990; Sheldon, 1984; Briscoe & LaMaster, 1991; Salam & Koumy, 1999; Carrell, et al., 1989; Kaufman, 1992), and facilitates recall (Armbruster & Anderson, 1980; Ruddell & Boyle, 1989).

Furthermore, engaging in concept mapping training helps students "learn how to learn." Concept mapping training may foster self-regulation because the students will have opportunity to monitor, to control, to make decisions about, and to organize their own learning. Concept mapping may present a clear picture of what students are learning and errors in learning will be more obvious. In turn, students' study skills and academic self-regulation may be improved. This is an important benefit as self-regulation is known to be related to academic achievement, as discussed in the following section. Furthermore, involving in concept mapping activities may increase the students' self-efficacy which is influenced by self-regulatory processes. Self-efficacy is also important to support achievement. Therefore, besides the theoretical foundations of concept mapping, self-regulation theory, self-efficacy, and research evidence are also discussed.

Social Cognitive Theory of Self-Regulation

Components of Self-Regulation

The conceptual framework employed in the present study for self-regulation is based on Bandura' s (1986, 1991) social cognitive theory. Self-regulation is accomplished when learners take charge of their own learning (Zimmerman & Martinez-Pons, 1988; McCombs & Marzano, 1990). Schunk (1994) argued that self-regulation occurs when students exhibit behaviors derived from strategies, that would eventually result in the completion of a learning goal.

Social cognitive theory views self-regulation as comprising four components: goal setting, self-observation, self-judgment, and self-reaction (Bandura, 1986; Schunk, 1989). The major component involved in self-regulation is the process of goal setting. The other three components of self-regulation (self-observation, self-judgment, and self-reaction) are believed to interact among each other and assist the process of goal attainment (Schunk, 1990; Zimmerman, 1989).

Goal Setting. Schunk (1990) stated that there are certain considerations that need to be made before goals can be defined and accomplished. Appropriate goal setting depends on specificity, proximity, and level of difficulty of the desired goal. Goals that denote specific performance standards are more likely to enhance behavior than general goals (e.g., "Do your best"). Challenging but attainable goals increase motivation and learning more than goals perceived as very easy or overly difficult (Schunk, 1991). When students adopt a goal they may experience a sense of efficacy for attaining it, which motivates them to engage in appropriate activities, to attend to instruction, to persist, and to expend effort. Additionally, social learning theorists propose that people are more likely to be motivated to work toward goals, and thus more likely to accomplish them, when they have set those goals for themselves rather than when others have imposed goals upon them (Schunk, 1985). However, goals are beneficial only to the extent that they are accomplishable; if they are unrealistically high, the continual failure to achieve them may result in excessive stress or depression (Bandura, 1986). After using specificity, proximity, and level of difficulty to determine what goal is appropriate, the other self-regulatory behaviors can aid in completion of the goal.

Self-Observation. There are three self-regulatory processes that compliment the act of goal setting. The first of these is the act of self-observation. Self-observation is deliberate attention to aspects of one' s behavior. Self-observation is necessary but, by itself, is insufficient for sustained self-regulation. The information gained from self-observation lets the student know if the proper performance is achieved, and if not, what needs to be done to accomplish the behavior (Schunk, 1990). Self-observation is most helpful when it addresses the specific conditions under which the behaviors occur (Zimmerman & Schunk, 1989). For instance, students who notice that they accomplish less when they study with a friend than when they study alone may establish a new routine of studying by themselves if their primary goal is academic achievement. According to Schunk (1990), an increase in the student' s motivation should occur if a consistent progression towards the goal is observed.

Self-judgment. Self-judgment is the second self-regulatory process that can assist the achievement of goals. Self-judgment consists of evaluating the performance at present in light of the goal to be accomplished (Schunk, 1990). Such comparisons inform one of goal progress and can exert motivational effects on future performance. In this step simple observations about progress toward a goal are made, as well as judgments about that progress.

Self-Reaction. Following self-judgment, self-reaction plays an important role in the self-regulation process. During this process of regulation, progress is evaluated and determined to be acceptable or not acceptable. For example, if students did well in comparison with their standards, they give themselves rewarding self-reactions. If they did poorly, they give themselves punishing self-reactions. These self-reactions can range from the obvious (treating themselves to a sundae or working late) to the more covert (feelings of pride or shame). The belief that one is making progress, along with the anticipated satisfaction of goal attainment, enhances self-efficacy, and sustains motivation (Schunk, 1990; Zimmerman, 1989).

The following example illustrates how goal setting, self-observation, self-judgment, and self-reaction processes interact with one another. At the start of learning activities students have such goals as acquiring skills and knowledge, finishing work, and making good grades. As they work, students observe, judge, and react to perceptions of their goal progress. As students observe aspects of their behavior, they judge their progress against standards and react positively or negatively. Their judgments and reactions set the stage for additional observations of the same behaviors or of others. These processes also interact with the environment (Zimmerman, 1989). Students who judge their learning progress as inadequate may react by asking for assistance from the teacher. Teachers then may teach students a more efficient strategy, which students can use to foster learning. That environmental factors can help develop self-regulation is important, because educators increasingly are advocating teaching students self-regulatory strategies (Schunk, 1989; Zimmerman, 1990).

Self-regulation theory focuses attention on how students personally activate, alter, and sustain their learning practices in specific contexts (Zimmerman, 1986). The literature on self-regulated learning (i.e. Zimmerman, 1990; Schunk, 1990, 1994) indicates that self-regulated learners understand, value, and engage in academic learning in ways that are fundamentally different from their peers who have difficulty learning.

Self-regulation fits well with the contemporary notion that students are not passive recipients of information, but rather exert control over the setting and attainment of their learning goals (Pintrich, Cross, Kozma & McKeachie, 1986). According to Zimmerman (1986), theorists view students as metacognitively, motivationally, and behaviorally active participants in their own learning process. Metacognitively, self-regulated learners are persons who plan, organize, self-instruct, self-monitor, and self-evaluate at various stages during the learning process. Motivationally, self-regulated learners perceive themselves as competent, self-efficacious, and autonomous. Behaviorally, self-regulated learners select, structure, and create environments that optimize learning. According to this view, effective learners become aware of functional relationships between their patterns of thought and action (often termed strategies) and social and environmental outcomes. The effective use of self-regulation strategies is theorized to enhance perceptions of self-control (i.e., autonomy, competence, or efficacy), and these positive self-perceptions are assumed to be the motivational basis for self-regulation during learning (Zimmerman, 1986).

There are metacognitive control strategies and self-regulatory learning strategies that students can use to improve their learning such as planning and monitoring (Carno, 1986; Pintrich & DeGroot, 1990; Zimmerman & Martinez-Pons, 1986). Most models of metacognitive control or self-regulating strategies include three general types of strategies---planning, monitoring, and regulating (Carno, 1986; Zimmerman & Martinez-Pons, 1986). Although these three types of strategies are highly related and seem to be highly correlated empirically, they can be discussed separately (Zimmerman & Schunk, 1989).

Planning activities that have been investigated in various studies of students' learning include setting goals for studying, skimming a text before reading, generating questions before reading a text, and doing a task analysis of the problem. These activities seem to help the learner to plan their use of cognitive strategies and also seem to activate or to prime relevant aspects of prior knowledge, making the organization and comprehension of the material much easier. Learners who report using these types of planning activities seem to perform better on a variety of academic tasks in comparison to students who do not use these strategies (McKeachie, Pintrich, & Lin, 1985; Pressley, 1986).

Monitoring one's thinking and academic behavior seems to be an essential aspect of metacognition. Weinstein and Mayer (1986) see all metacognitive activities as partly the monitoring of comprehension. Monitoring activities include tracking of attention while reading a text or listening to a lecture, self-testing through the use of questions about the text material to check for understanding, monitoring comprehension of a lecture, and the use of test-taking strategies (i.e., monitoring speed and adjusting to the time that is available) in an exam situation. These various monitoring strategies alert the learner to breakdowns in attention or comprehension that can then be subjected to repair through the use of regulating strategies. According to Butler and Winne (1995), self-monitoring is central to self-regulated learning. Students self-monitor when they reflect on various aspects of their performances and generate internal feedback regarding progress. Self-monitoring occurs when a student determines whether a target behavior has or has not occurred and then records the result in some way (Nelson, 1977; O' Leary & Dubey, 1979). Thus, by definition, self-monitoring contains two components: (a) self-assessment and (b) self-recording. Determining whether a behavior has or has not occurred is self-assessment. Students may self-assess many aspects of a specific behavior (e.g., occurrence, duration, intensity, and frequency). Although self-assessment can be done alone, it works best for most students in combination with self-recording (Harris & Graham, 1992). In practice, once students become adept at self-monitoring, they may choose to use self-assessment alone; however, self-recording necessarily involves appraisal and thus will always be used in combination with self-assessment (Graham, Harris, & Reid, 1992).

Regulation strategies are closely tied to monitoring strategies. For example, when learners ask themselves questions as they read in order to monitor their comprehension, and then go back and reread a portion of the text, this rereading is a regulatory strategy. Another type of self-regulatory strategy for reading occurs when a student slows the pace of reading when confronted with more difficult or less familiar text. Of course, reviewing any aspect of course material (e.g., lecture notes, texts, lab material, previous exams, and papers, etc.) that one does not remember or understand well while studying for an exam, reflects a general self-regulatory strategy. During a test, skipping questions and returning to them later is another strategy that students can use to regulate their behavior during an exam. All these strategies are assumed to improve learning by helping students correct their studying behavior and to repair deficits in their understanding (Schunk & Zimmerman, 1994).

In this study, the researcher expects that concept mapping will have the greatest influence on the skills referred to as self-observation by Bandura and as monitoring and regulating by other self-regulation researchers. In the present study, monitoring of comprehension refers to checking for gaps in understanding of new material. Another skill that is expected to be influenced by concept mapping is knowledge acquisition strategy (those that explicitly link new concepts/ideas to each other and to prior knowledge).

Review of Self-Regulation Research

There is a growing body of applied research on the relationship between self-regulated learning processes and student academic achievement (Bandura, 1986; Schunk, 1984). In an interview study conducted by Zimmerman and Pons (1986), it was found that high school students' use of 14 categories of self-regulated learning strategies during class and study was highly related to their academic achievement. These strategies included self-evaluation, organizing and transforming, sub-goal setting, planning, seeking information, keeping records and self-monitoring, environmental structuring, self-consequences, rehearsing and memorizing, seeking peer, teacher, or adult assistance, and reviewing notes, tests, or textbooks.

In this study, eighty students were asked to describe the methods they used in six learning contexts and to rate their consistency in using each method. Reported use of these strategies proved to be highly correlated with academic achievement. Students' placement in advanced versus other achievement tracks in their school were predicted with 93% accuracy. Students in the two achievement groups differed significantly in their mention of nearly all categories of self-regulation. These results clearly indicated that high school students' uses of metacognitive strategies were highly related to their achievement level.

In another study, Zimmerman and Martinez-Pons (1988) also found that students' reports of using self-regulated strategies were highly correlated with a factor derived from teachers' judgments of students' self-regulation during class and the students' achievement test scores. The teachers were asked to rate such responses as students' (a) timely completion of assignments, (b) solicitation of additional information or help, (c) awareness of test performance before grading, and (d) preparation for and interest in class. These data indicated that strategies that had been derived from social cognitive theory and self-regulation laboratory training research were highly predictive of students' performance in class (Zimmerman & Martinez-Pons, 1988).

Similarly, Owings, Peterson, Bransford, Morris, and Stein (1980) also conducted a study to determine if self-regulation aids in learning, and whether students at different cognitive levels differ in their use of these behaviors. Sixteen high achieving and sixteen low achieving fifth graders participated in this study. Teacher ratings and test performance determined the grouping of students. The students were given both a difficult and an easy passage to read. After each passage was read, the students were tested on the material included in the passage. Besides being tested, the students were asked to rate the passages as either difficult or easy. The students then had to justify why the passage was described as difficult or easy.

The results of the Owings et al. (1980) study showed that the higher performing students engaged in more self-regulatory behaviors than their less successful counterparts. The lower achieving readers took more time to read and less time to study the passages. These students also performed more poorly on the memory tests for the passages. This study points out that often times self-regulatory behaviors for learning are not as readily available for less successful students. Thus, these types of behaviors should be taught to all students, but when teaching less successful students, special attention needs to be given to these behaviors.

Additionally, Butler (1997) described research evaluating one intervention model designed to promote self-regulated learning by post-secondary students with learning disabilities, the Strategic Content Learning (SCL) approach. The SCL aims to teach students how to engage recursively in the full set of activities central to self-regulation by providing calibrated (scaffolded) support as students self-regulate their engagement in tasks. In this review article, Butler (1997) summarized the results from four studies evaluating SCL efficacy as a model for providing individual tutoring for learning disabled post-secondary students. The results of the four studies suggested that participants benefit from SCL instruction. Analyses revealed positive shifts in students' knowledge and beliefs central to effective self-regulation, including metacognitive strategies about tasks, strategies, and self-monitoring, perceptions of task-specific self-efficacy, and attributional beliefs. The findings also suggested that students improved in implementation of component cognitive progresses and in coordination of learning activities (Butler, 1997).

The above studies provided evidence of the efficacy and efficiency of self-regulated strategies. Thus, helping students to become self-regulated learners is an important educational task. Harris and Graham (1992) stated that improving students' self-regulation abilities is important in academic settings for at least three reasons:

1. Learning to self-regulate their behaviors allows students to become more independent. In addition to the many positive benefits this creates for students, it also reduces demands on teacher time.
2. Learning to use self-regulation procedures often increases the students' level of task engagement; thus, in addition to facilitating learning, it may decrease disruptive or off-task behaviors.
3. Perhaps what is most important, self-regulation techniques enable students to monitor and to regulate their own academic performance.

Furthermore, in this study, it was hypothesized that self-efficacy would be influenced by the self-regulation process during concept mapping training. By engaging in concept mapping, the students would have an opportunity to monitor their performances and to compare their attainments with their goals to determine progress. Such progress indicators convey to students that they are capable of performing well, which enhances self-efficacy. Self-efficacy is an important foundation for learner motivation and academic achievement. Thus, in the following section, self-efficacy theory and related studies are discussed.

Self-Efficacy Theory

Self-efficacy is a major construct in Bandura's (1986) social cognitive theory, and a key factor in self-regulatory mechanisms governing individuals' motivation and action. It is defined as personal beliefs concerning one's capabilities to learn or perform skills at designated levels (Bandura, 1986; Schunk, 1991). According to social cognitive theories (Bandura, 1977; Schunk, 1989), people's feelings of self-efficacy affect several aspects of their behavior, including their choice of activities, their effort and persistence, and ultimately, their learning and achievement. The students tend to choose tasks and activities at which they believe they can succeed. They also tend to avoid those at which they think they will fail. The most useful efficacy choices are tasks which slightly exceed an individual's abilities and direct the individual to realistically challenging tasks. Also, the students with a high sense of self-efficacy are more likely to exert effort in attempting to accomplish a task. They are also more likely to persist when they encounter obstacles. On the other hand, students with low self-efficacy about a particular task will put less effort into it and will give up more quickly in the face of difficulty. In addition, students with high self-efficacy tend to learn and achieve more than students with low self-efficacy, even when actual ability levels are the same (Bandura, 1986; Schunk, 1989; Zimmerman, Bandura, & Martinez-Pons, 1992).

Bandura (1986) described three dimensions upon which self-efficacy may vary that can impact performance. First, efficacy judgments differ in level. With regard to the level of difficulty of specific tasks within a particular domain, the self-efficacy of different individuals may be limited to simpler tasks or may extend to more difficult ones.

Second, perceived self-efficacy varies in strength. Stronger perceived self-efficacy is associated not only with the selection of more challenging activities, but also with greater persistence, effort, and success in performing those activities. Third, perceived self-efficacy differs in generality or the degree to which an individual's self-precepts extend across tasks in different domains.

Strategy instruction is an effective means of promoting self-regulated learning and perceived efficacy (Carno & Mandinach, 1983; Schunk, 1986). Strategies help students attend to tasks, focus on important features, organize material, and maintain a productive psychological climate for learning (Weinstein & Mayer, 1986). Self-regulated learners apply strategies and understand how strategies improve their performance. Research has shown that use of strategies relates positively to achievement and self-efficacy (Borkowski, Carr, Rellinger, & Pressley, 1990; Pintrich & DeGroot, 1990; Zimmerman & Martinez-Pons, 1992).

Review of Self-Efficacy Research

Studies Utilizing Classroom-Related Performance Measures

Pintrich (1989) examined the interactive relationships between student motivation and cognition and student performance on different college tasks. Participants included 224 college students enrolled at three institutions of higher learning, a four-year state university, a small liberal arts college, and a community college. Self-efficacy was measured by the Expectancy for Success subscale contained within the Motivated Strategies for Learning Questionnaire (MSLQ). The MSLQ is a self-report questionnaire that asks students to rate themselves on a variety of motivational and cognitive items. Academic achievement was measured by course performance. There was variation of course performance measures across the different classes but it generally consisted of three types of assignments or tasks which included exams, essays or papers, and labs. The results of this study suggested that self-efficacy was related to the cognitive and metacognitive study strategies that were included in this study.

Lent, Lopez, and Bieschke, (1993) examined the relations among several variables including: prior achievement, self-efficacy, outcome expectations, and prediction of students' choice of and performance in mathematics-related college courses. The participants included in the study were 166 students who were enrolled in introductory psychology courses at a large university.

Mathematics self-efficacy was measured with a revised version of Betz and Hackett's (1983) Mathematics Self-Efficacy College Courses Scale. The participants were asked to rate on a 10-point scale confidence regarding their ability to complete a variety of mathematics-related college courses with a grade of B or better. Fifteen courses were listed on the questionnaire. The performance measure used in the study was students' grades in a mathematics-related course. In this study, the results indicated that mathematics course grades and mathematics self-efficacy beliefs were significantly correlated.

Schunk and Rice (1999) investigated the effects of sources of strategy information on children's acquisition and transfer of reading outcomes and strategy use. The participants were 33 students (21 fourth graders, 12 fifth graders) drawn from one elementary school. The students were assigned randomly to one of three experimental conditions: strategy instruction, strategy value feedback, and instructional control. Students received 35-minute instructional sessions over 15 consecutive school days, during which they worked on a packet of materials. Prior to the intervention, the pretest comprised measures of self-efficacy and comprehension skill.

The experimental procedure for children assigned to the strategy instruction and to the strategy value feedback conditions was as follows. The teachers distributed the packet at the start of the first session. After distributing the packet, the teacher pointed to the poster board and modeled the strategy and its application. Following this modeled demonstration, the teacher and students worked on another passage and its questions. The teacher instructed the children to repeat aloud each step after she verbalized it. After the children verbalized each of the statements, the teacher selected one student to perform the corresponding actions. Strategy value feedback linked children's successes at answering comprehension questions with their proper application of the strategy. Each child assigned to this condition received feedback three or four times during each instructional session. The teacher delivered feedback after a child properly performed a step or answered a question correctly. Students assigned to the instructional control condition received the same amount of instruction as students in the other two conditions, except that it did not include the comprehension strategy.

On completion of the instructional program, the children received the posttest. The results showed that strategy value feedback led to the highest self-efficacy, skill, and maintenance of strategy use. Such feedback conveys to students that the strategy is effective, they are making progress in learning, and they are capable of continuing to improve their skills. These beliefs are validated as students successfully apply the strategy. Strategy instruction only students did not differ from control group students on self-efficacy or skill.

In conclusion, research studies in different settings showed that self-efficacy helps to explain and predict achievement behaviors. Students with high self-efficacy had higher achievement. The teaching of learning strategies not only improved learner performance but also self-efficacy. Self-efficacy was related to use of learning strategies. Students who believed they were capable of performing tasks used more learning strategies and persisted longer at those tasks than those who did not.

Current Study

Concept mapping is an ideal strategy to be introduced in classrooms, including ESL classrooms. Most of the studies reviewed were in agreement that there was improved performance by students who were trained in the concept mapping strategy. The process of developing a concept map forces students to organize, categorize, analyze, evaluate, and reason critically. Concept mapping requires students to connect new information to prior knowledge. Concept mapping promotes meaningful learning rather than rote learning. Additionally, concept mapping may encourage students to engage in self-regulatory processes, because concept mapping makes explicit learners' opportunity to monitor, to control and to direct their own learning. Furthermore, increases in self-regulation may promote learners' self-efficacy.

Variables of interest in the current study were (a) students' achievement when learning from text, (b) students' reports of use of self-regulation strategies, and (c) students' self-efficacy for learning from text in English. This study took place during the second seven weeks of the fall semester within the context of reading in English as a Second Language classroom at the Center for English as a Second Language at the University of Oklahoma.

The research questions concerning concept mapping, self-regulation and self-efficacy were as follows: (1) Do ESL students in a concept mapping group show greater achievement than students in an alternative learning strategy group? (2) Do ESL students in a concept mapping group show greater self-regulation of learning (monitoring and knowledge acquisition strategies) than students in an alternative learning strategy group? and (3) Do ESL students in a concept mapping group show greater self-efficacy than students in an alternative learning strategy group?

CHAPTER THREE

METHOD

Design

This study took place during the second seven-week session of the fall semester within the context of reading in an English as a Second Language classroom at the Center for English as a Second Language. A randomized pretest-posttest control group design with (a) concept mapping group and (b) an alternative learning strategy group was employed. Prior to the intervention, the concept mapping group and the alternative learning strategy group were administered pre-tests in achievement, self-regulation (self-monitoring and knowledge acquisition), and self-efficacy. After the intervention, all participants were given the post-tests in the same manner as the pretests.

Hypotheses

1. The concept mapping group will score significantly higher on an achievement posttest than the alternative learning strategy group.
2. The concept mapping group will score significantly higher on the self-regulation posttest than the alternative learning strategy group.
3. The concept mapping group will score significantly higher on the self-efficacy posttest than the alternative learning strategy group.

Participants

The sample for the study comprised seventy-nine volunteers from the entire population (N = 82) of International students who were studying English during the second seven week session of the fall semester of 2000 at the Center for English as a

Second Language (CESL). These students were full time students. They were unable to study at any school until they passed the TOEFL (Test of English as a Foreign Language).

CESL offers an intensive English language program that is designed for highly motivated students who wish to master English quickly and thoroughly. CESL offers two seven-week sessions in the fall and spring semesters, with twenty-five hours of instruction per week. Normally, before starting each session, the ESL students will be classified into four different levels of their English language ability background by using the Michigan test (1989), with approximately 18-20 students per level. These levels are: (a) Beginner, (b) Intermediate, (c) Advanced, and (d) Expert.

In the current study, seventy-nine students from all levels volunteered to participate in the study. There were nineteen students from the beginner level, and twenty students from each level of the intermediate, advanced, and expert. There were two experimental groups. In order to increase representativeness, stratified random assignment was employed to assign students to equal sized groups. To form a concept mapping group, the researcher randomly selected 50 percent from each level (strata) of the sample. The remaining students served as an alternative learning strategy group. Finally, there were forty participants in the concept mapping group and thirty-nine participants in the alternative learning strategy group.

Instructors

The researcher trained a native English speaking teacher who has taught English at CESL for many years in the use of the concept mapping strategy. This instructor conducted formal presentation and lessons. Both the researcher and the trained instructor worked together in the classroom with the concept mapping group and the alternative learning strategy group to give individual feedback. All sessions were conducted outside of regular class time.

Materials

Five reading passages constituted the instructional materials for the experiment. These passages were drawn from different types of reading materials such as newspapers, magazines and TOEFL (Test of English as Foreign Language) model tests. In this study, all participants were given the same set of reading passages. Concept mapping instruction was adapted by the researcher from Novak and Gowin (1984). This is included in Appendix A.

Instruments

A pilot study was conducted in order to assess the psychometric properties of instruments that measured students' learning from text, self-regulation, and self-efficacy. The administration of the pilot study took place during the third week of the fall 2000 semester. Thirty-two ESL students who were studying English at CESL at Oklahoma City University during the fall of 2000 participated in the study. None of the participants in the pilot study participated in the main study. These students were classified by CESL into three different levels of their English language ability background. These levels were: (a) Beginner, (b) Intermediate, (c) Advanced, and (d) Expert. All levels were represented in the pilot sample. Prior to data collection, the participants received informed consent forms explaining the purpose and confidentiality of the study. The students who wished to participate were asked to complete two instruments.

The Survey of Learning Behaviors. This instrument was modified from the "Attitude Toward Mathematics Survey" that was used in two studies conducted by Miller, Green, Montalvo, Ravindran, and Nichols (1996). Originally, this survey was used to assess the following variables: (a) goals for doing the academic work assigned in Math class; (b) self-perception of ability for Math class; (c) self-regulation and cognitive strategy use in studying for Math class; (d) persistence when faced with difficult problems in Math class; and (e) effort compared to other classes. The Likert scales were anchored with "strongly disagree" and "strongly agree." The questions were focused on the mathematics classes in which the students were currently enrolled. Cronbach alpha reliability coefficients from these two studies (Miller et al., 1996) for the self-regulation and perceived ability (self-efficacy) subscales of the "Attitude Toward Mathematics Survey" were as follows: self-regulation .80/.78 and perceived ability .93/.93.

In the current study, the "Attitude Toward Mathematics Survey" was modified to fit the appropriate subject domain and the learning strategy in the present study by reducing the number of subscales, by adding new items, and by changing the language and response options. Finally, the survey used in this study consisted of three different subscales: (a) self-regulation: self-monitoring subscale, (b) self-regulation: knowledge acquisition subscale and (c) self-efficacy subscale. There were 14 items measuring self-regulation, 9 items for the self-monitoring subscale, and 4 items for the knowledge acquisition strategy subscale. There were 7 items measuring self-efficacy. The participants were asked to indicate their degree of agreement to the given statement using a five-point scale (1 = never; 5 = always). High scores on the subscale indicated a greater degree of the construct being measured. Low scores on the scale represented a lower degree of the construct being measured.

Before conducting the pilot study, this survey was also validated by instructors from the Department of Educational Psychology for the appropriateness of language level, relevance, and representativeness of the construct defined in this study. Reliability analysis of pilot data resulted in a Cronbach alpha reliability coefficient of .82 for the entire scale, .81 for self-monitoring, .78 for knowledge acquisition, and .75 for self-efficacy. The Survey of Learning Behavior is included in Appendix B.

The Achievement Test. The achievement test was used to measure the students' understanding of reading passages before and after the experimental period. This achievement test covered the information from five reading passages, including comprehension level items, and application level items or above (Bloom, 1956). Initially, a 52-item achievement test was constructed covering five different reading passages (see Appendix C). The achievement test employed a multiple choice format with four alternative options. The overall difficulty level of the achievement test was moderate. Both easy and difficult items were included in the test. Reading passage also differed in difficulty. The first three passages were selected from the TOEFL model tests (Sharpe, 1999) and their difficulty was considered as easy to moderate in magnitude. The last two reading passages were more difficult and longer than the first three passages. They were drawn from the "Wild Life" magazine (Feb, 1999).

Content validity of the achievement items was assessed by an instructor from the Department of Educational Psychology and English teachers having expertise regarding teaching ESL students. They were asked to evaluate the extent to which the language was adequately and appropriately used and that passage content was adequately sampled. The 52-item achievement test was piloted with the international students who were studying at the CESL at the Oklahoma City University during the fall of 2000. Then item difficulty was assessed and the achievement test was revised. The table of item difficulty is provided in Appendix D. Finally, the revised instrument measuring the students' understanding of reading passage for the main study consisted of 33 items (see Appendix E). The characteristics for each reading passages as follows:

(1) The Acacia Reading Passage. There were ten original items for this passage. Based on the item analysis, six items were used in the main study.

(2) The Horace Mann Reading Passage. There were 11 original items for this passage. Following item analysis, five easy items were removed from the instrument leaving six items for the main study.

(3) The Wright Brothers Reading Passage. Ten items were developed for this reading passage. There were seven items retained for the main study after four easy items were deleted from the instrument.

(4) The Pika Cycle Reading Passage. Eleven items were developed for this article. There were seven items retained in the main study.

(5) The British Corals Reading Passage. There were ten original items from this passage and seven items were used in the main study.

Procedure

Before the intervention began, the researcher received informed consent letters from the director of the CESL and the participants to get permission to conduct the study. This student informed consent letter provided an explanation of the purpose of the study, the experimental procedures, the amount of time required for the subject' s participation, confidentiality, and the potential risks and benefits of participation.

Treatment. The treatment phase consisted of four sections (a) pre-testing, (b) learning strategy training, (c) learning strategy practice, and (d) post-testing. It lasted for four weeks and was conducted outside a regular classroom at the lobby area. The treatment phases are outlined in Table 1.

Table 1

Treatment Phases for Concept Mapping Group and Alternative Learning Strategy Group

Concept Mapping		Alternative Learning Strategy	
Pre-testing			
Week 1: Thursday	Part 1	Week 1: Thursday	Part 1
Week 1: Friday	Part 2	Week 1: Friday	Part 2
Treatment			
Week 2: Monday	CM Training CM Practice A1	Week 2: Tuesday	ALS Training ALS Practice A1
Week 2: Wednesday	CM Practice A2	Week 2: Thursday	ALS Practice A2
Week 2: Friday	CM Practice A3	Week 3: Monday	ALS Practice A3
Week 3: Tuesday	CM Practice A4	Week 3: Wednesday	ALS Practice A4
Week 3: Thursday	CM Practice A5	Week 3: Friday	ALS Practice A5
Post-testing			
Week 4: Monday	Part 1	Week 4: Monday	Part 1
Week 4: Tuesday	Part 2	Week 4: Tuesday	Part 2

Note. A1 = Acacia, A2 = Horace Mann, A3 =Wright Brothers, A4 = Pica Cycle, A5 = British Corals.

Pre-testing. Before students received any instruction, all the participants (the concept mapping and the alternative groups) were given the Achievement Test and the Survey of Learning Behaviors as a pre-test. Due to the length of the instrument, the pretests were split over two sessions. The pretest-1 included three reading passages and was administered on Thursday during the first week of the intervention. The pretest-2 contained two reading passages plus the Survey of Learning Behaviors and was given to students on Friday of the first week.

Learning strategy training. A familiarization session was provided for the concept mapping group where the students became familiar with concept mapping strategy. Students received handouts that included an introduction to concept mapping as a learning strategy, the characteristics of concept maps, and examples of good and poor concept maps (see Appendix F). The experimenters introduced concept mapping to students by using "the strategy for introducing concept mapping for ESL students." This is included in Appendix A. The concept mapping training was provided to students on Monday of the second week. On the same day, the concept mapping group students practiced the strategy with the experimenters. The students were given the first reading passage (A1: Acacia), including some definitions of difficult vocabulary from this passage, to read and asked to map their understanding on a blank sheet of paper. The students were also invited to use their prior knowledge to support and to explain their understanding by adding this information in their concept maps. Students had 30 minutes of concept mapping practice. During this period, the experimenters monitored students and provided feedback. The students' concept maps were collected to provide feedback in the subsequent meeting.

In the alternative learning strategy group, the students studied the same reading materials through asking the teacher questions. In this group, the students were given the first reading passage (A1: Acacia), including some definitions of difficult vocabulary from this passage, to read for 30 minutes. This learning group did not carry out the concept mapping strategy. The students in this group studied the reading passages in a manner typical of that used by their teachers in ESL class. If students had questions about the reading passage, the experimenters would answer and clarify the student's questions. Finally, the instructor summarized the main ideas from the passage. The alternative learning strategy training was given to students on Tuesday of the second week.

Learning strategy practice. During the second week, the concept mapping group students came to practice the strategy again on Wednesday using reading passage (A2: Horace Mann) and on Friday using reading passage A3 (Wright Brothers). The procedures described above for the first practice were followed. Before the concept mapping students started concept mapping practice, the experimenters returned the students' concept maps from the previous meeting. In this study, the students' concept maps were not graded, but experimenters' feedback was provided. The students were encouraged to be as precise as possible in their representation of relationships in their maps.

The alternative learning strategy group was given the same reading passage as the concept mapping group following the procedure from the first practice. This group came to study a passage A2 (Horace Mann) on Thursday of the second week, and A3 (Wright Brothers) on Monday of the third week. This process continued until each group had studied each of the five reading passages. In this study, the students in both the concept mapping group and alternative learning strategy group had one hour of practice for reading passages A2-A5 (Horace Mann, Wright Brothers, Pica Cycle, and British Corals).

During the practice sections, there were some students in each group who were unable to participate according to the project's schedule. Experimenters contacted these students individually for a make-up session.

Post-testing. After concept mapping or alternative learning activities were completed, all participants from the concept mapping group and alternative group were administered the post-tests in the same manner as the pretests.

In the current study, because of the study's design, only the 40 students in the concept mapping group had the opportunity to learn and practice the concept mapping strategy. Therefore, after the post-test administration, a one- hour introductory session on how concept maps are made was provided for the alternative learning strategy group.

Data Analyses

The data for the study were analyzed using the SPSS statistical software package. To determine that the two treatment groups were initially equivalent, a T-Test was performed comparing the two groups on all pre-test measures. One Sample T-Tests were computed to assess pre-test to post-test changes for each variable in each treatment group.

There were two main different analyses for the study: one for the achievement measures and one for the learning behaviors measures (self-regulation and self-efficacy). In the first analysis, a Split-Plot Analysis of Variance was performed to determine whether there was a main effect for treatment group, a main effect for time, or a group by time interaction for achievement. The independent variable was treatment group including the: (a) concept mapping group and (b) alternative learning strategy group. In this analysis, treatment group was the between-subjects factor. The repeated measure was time including: (a) a pre-test and (b) a post-test. The dependent variable was achievement in learning from text. Thus, in the first data analysis a 2 (treatment) x 2 (time) Split-Plot ANOVA was performed.

In the second analysis, for the learning behaviors measures, a Split-Plot Multivariate Analyses of Variance was performed to determine whether there was a main effect for treatment group, a main effect for time, or a group by time interaction for self-monitoring, knowledge acquisition strategy or self-efficacy. In this case, the independent variable was treatment group (concept mapping group, and alternative learning strategy group). Treatment group was the between-subject factor. Time was the within-subjects factor. In the second analysis, the dependent variables were self-regulation (self-monitoring and knowledge acquisition strategy), and self-efficacy. Therefore, a 2 (treatment) x 2 (time) Split-Plot MANOVA was performed.

Data Cleaning

Before main analyses were computed, data cleaning and evaluation of assumptions was performed to assess the variables with respect to practical limitations of the techniques. General results showed that all dependent variables in each group had reasonably balanced distributions so there was no need to examine scatter-plots for each pair of dependent variables within each group. Although a univariate outlier on the self-monitoring variable was found, the researcher decided to keep it for the main analyses because its magnitude was not extremely high. Results of evaluation of assumptions of normality, homogeneity of variance-covariance matrices, linearity, and multicollinearity were satisfactory.

In addition, the distribution of responses for each item on the Survey of Learning Behaviors was examined. Item five showed a bimodal distribution with fifty percent of scores in the top and fifty percent of scores in the bottom of the distribution. For this reason, item five was deleted from the instrument. This left three items constituting the knowledge acquisition strategy scale.

CHAPTER FOUR

RESULTS

This chapter is organized in the following manner. In the first section, descriptive statistics will be presented. The second section is the data analyses related to the achievement data. The third section is the data analyses related to the self-regulation (self-monitoring and knowledge acquisition) and self-efficacy data.

Descriptive Statistics

The means, standard deviations and Cronbach's alpha for achievement, self-monitoring, knowledge acquisition, and self-efficacy by method of instruction are presented in Table 2. Students in the concept mapping condition earned higher mean post-test scores on achievement than the alternative learning strategy group. There were higher post-test scores on achievement than on the pre-test in both groups. For the leaning behaviors data, students in the concept mapping group earned consistently higher mean post-test scores on self-monitoring, knowledge acquisition, and self-efficacy than the alternative learning strategy group. The standard deviations of these variables indicated that the scores in distributions of the concept mapping group and the alternative learning strategy group clustered about the means of the distributions.

Table 2

Means, Standard Deviations, and Cronbach's Alpha of the Pre-Test, and Post-Test Scores of the Treatment Groups in Achievement, Self-Monitoring, Knowledge Acquisition Strategies, and Self-Efficacy

	Ach	SM	KA	S-eff
Concept Mapping				
Pre-test	.45(.19)	2.39(.20)	2.23(.44)	2.52(.31)
Post-test	.80(.14)	4.31(.34)	4.21(.45)	3.87(.33)
Alternative Learning Strategy				
Pre-test	.44(.18)	2.44(.29)	2.18(.46)	2.63(.36)
Post-test	.64(.10)	3.13(.27)	2.94(.31)	3.66(.26)
Cronbach's alpha	___	.89	.78	.61

Note. Ach refers to Achievement. SM refers to Self-Monitoring. KA refers to Knowledge Acquisition. S-eff refers to Self-Efficacy.

Analyses of Group Differences

To determine that the two treatment groups were initially equivalent, a t-test was performed comparing the two groups on all pre-test measures. No significant differences between treatment groups on the pre-test for all variables were found. The finding indicates that students in the concept mapping group and the alternative learning strategy group did not differ on pre-test scores of achievement, self-monitoring, knowledge acquisition strategies, and self-efficacy. However, significant differences for all variables were found between groups on all measures at post-test (see Table 3).

Table 3

T-Test for Equality of Means of the Concept Mapping Group and the Alternative Learning Strategy Group on all Dependent Variables (Achievement, Self-Monitoring, Knowledge Acquisition Strategies, and Self-Efficacy) from both Pretests and Posttests

Dependent Variable	t-value	df	2-Tail Sig	Mean Diff	SE of Diff
Pre-tests					
Achievement	-.23	77	.82	.01	.04
	-.23	76.99	.82	.01	.04
Self-Monitoring	.99	77	.32	.06	.06
	.99	67.77	.32	.06	.06
Knowledge Acquisition	-.45	77	.66	.00	.10
	-.45	76.59	.66	.00	.10
Self-Efficacy	1.48	77	.14	.11	.26
	1.48	75.17	.14	.11	.26
Post-tests					
Achievement	-5.99	77	.00	-.16	.03
	-6.01	69.48	.00	-.16	.03
Self-Monitoring	-17.13	77	.00	-1.18	.07
	-17.18	73.74	.00	-1.18	.07
Knowledge Acquisition	-14.47	77	.00	-1.27	.09
	-14.53	69.75	.00	-1.27	.09
Self-Efficacy	-3.24	77	.00	-.22	.07
	-3.25	73.90	.00	-.22	.07

Note. Mean Diff refers to Mean Difference. SE of Diff refers to Standard Error Difference.

Achievement Data. For the achievement measure, a split-plot analysis of variance was performed to determine whether there was a main effect for treatment group, a main effect for time, or a group by time interaction. An alpha level of .05 was used for both tests of within-subjects effects and tests of between-subjects effects. Follow-up one sample t-tests were used to assess pre-test to post-test changes for each variable in each treatment group. Partial Eta Squared, an alternative form of Eta Squared, will be reported for those dependent variables where there is a main effect. This statistic can be interpreted as the proportion of variance in the dependent variable explained by differences among groups. Partial Eta Squared is being included in the results section because the percentage of variance explained gives an index of the magnitude of the effect found.

The tests of within-subjects effects revealed a main effect of time, $F(1, 77) = 743.00$, $p < .05$, Partial eta squared = .90 (see Table 4).

Table 4

Results of Split-Plot Analysis of Achievement Scores

Dependent Variable	F-value	df	MS	2-Tail Sig	partial Eta Squared
Achievement					
Group	6.54	1	.29	.01	.08
Time	743.00	1	2.99	.00	.90
Group by time	57.11	1	.23	.00	.42

Note. MS refers to Mean Square.

Table 5

Results of Split-Plot Analyses of Scores on Self-Monitoring, Knowledge Acquisition Strategies, and Self-Efficacy

Dependent Variable	F-value	df	MS	2-Tail Sig	partial Eta Squared
Self-Monitoring					
Group	161.12	1	12.55	.00	.67
Time	860.96	1	67.05	.00	.91
Group by time	194.45	1	15.14	.00	.71
Knowledge Acquisition					
Group	97.04	1	17.04	.00	.55
Time	409.22	1	74.34	.00	.84
Group by time	81.24	1	14.76	.00	.51
Self-Efficacy					
Group	.76	1	.11	.39	.01
Time	886.27	1	55.55	.00	.92
Group by time	16.95	1	1.06	.00	.18

Note. MS refers to Mean Square.

One-sample follow-up t-tests showed that the students in both the concept mapping group and the alternative learning strategy group had significantly higher means on the post-test of achievement than on the pre-test (see Table 6).

Table 6

One-Sample T Test of Pre-Test and Post-Test Scores for Each Variable by Treatment Group

Dependent Variable		t-value	df	2-Tail Sig	Mean Difference
Concept Mapping Group					
Achievement	Pre-tes	15.16	39	.00	.45
	Post-test	36.25	39	.00	.80
Self-Monitoring	Pre-test	75.06	39	.00	2.39
	Post-test	80.06	39	.00	4.31
Knowledge Acquisition	Pre-test	31.79	39	.00	2.23
	Post-test	59.02	39	.00	4.21
Self-Efficacy	Pre-test	50.70	39	.00	2.52
	Post-test	74.65	39	.00	3.87
Alternative Learning Strategy Group					
Achievement	Pre-test	15.09	38	.00	.44
	Post-test	41.25	38	.00	.64
Self-Monitoring	Pre-test	52.93	38	.00	2.44
	Post-test	72.89	38	.00	3.13
Knowledge Acquisition	Pre-test	29.32	38	.00	2.18
	Post-test	58.46	38	.00	2.94
Self-Efficacy	Pre-test	45.85	38	.00	2.63
	Post-test	87.96	38	.00	3.66

The tests of between-subjects effects also showed a main effect of method of instruction, $F(1, 77) = 6.54$, $p < .05$, Partial eta squared = .08 (see Table 4). From the means shown in Table 2, averaging across time, students in the concept mapping group had higher scores on achievement than students in the alternative learning strategy group.

There was also a significant interaction of time and method of instruction, $F(1, 77) = 57.11$, $p < .05$, Partial eta squared = .42 (see Table 4). Figure 5 shows greater differences between pre-test and post-test administrations in the concept mapping group than in the alternative learning strategy group. This finding supports the prediction that the students in the concept mapping group would show significantly greater scores on achievement than students in the alternative learning strategy group.

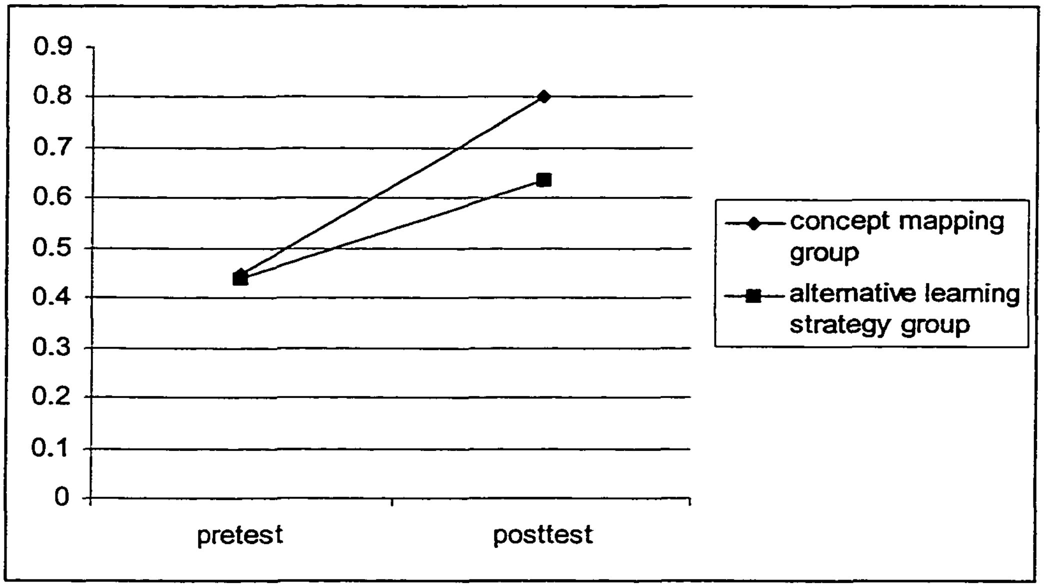


Figure 5. Interaction of time and method of instruction for achievement data

Self-Monitoring, Knowledge Acquisition Strategy, and Self-Efficacy Data. Mean differences were examined for statistical significance using a split-plot multivariate analyses of variance for the self-regulation variables (self-monitoring and knowledge acquisition strategies) and self-efficacy. An alpha level of .05 was used for both the multivariate and univariate tests. Follow-up one sample t-tests were performed to assess pre-test to post-test changes for each variable in each treatment group. Partial eta squared will be reported for those dependent variables where there is a main effect.

The Wilks Lambda test of significance showed a significant main effect of time, $F(1, 77) = 424.61$, $p < .05$ and a significant main effect for method of instruction, $F(1, 77) = 77.41$, $p < .05$ (see Table 5). The univariate tests demonstrated main effects of time for self-monitoring, $F(1, 77) = 860.96$, $p < .05$, Partial eta squared = .91, knowledge acquisition strategies, $F(1, 77) = 409.22$, $p < .05$, Partial eta squared = .84, and self-efficacy, $F(1, 77) = 886.27$, $p < .05$, Partial eta squared = .92. One-sample t-tests also indicated that the students in both the concept mapping group and the alternative learning strategy group had significantly higher means on self-monitoring, knowledge acquisition strategies, and self-efficacy in post-tests than in pre-tests (see Table 6).

Univariate tests showed significant main effects of method of instruction for self-monitoring, $F(1, 77) = 161.12$, $p < .05$, Partial eta squared = .67 and knowledge acquisition strategies, $F(1, 77) = 97.04$, $p < .05$, Partial eta squared = .55. Averaging across time, students in the concept mapping group showed greater scores on self-monitoring and knowledge acquisition strategies than students in the alternative learning strategy group. No significant main effect of method for self-efficacy, $F(1, 77) = .762$, $p = .39$, Partial eta squared = .01 was found.

The Wilks Lambda test indicated a statistically significant interaction of time by method of instruction, $F(1, 77) = 67.83$, $p < .05$. The Univariate tests indicated a significant interaction of time and method of instruction for self-monitoring, $F(1, 77) = 194.45$, $p < .05$, Partial eta squared = .71 (see Figure 6), knowledge acquisition strategies, $F(1, 77) = 81.24$, $p < .05$, Partial eta squared = .51 (see Figure 7), and self-efficacy, $F(1, 77) = 16.95$, $p < .05$, Partial eta squared = .18 (see Figure 8). Figure 6 and Figure 7 show greater differences on self-monitoring and knowledge acquisition strategies between pre-test and post-test administrations in the concept mapping group than in the alternative learning strategy group.

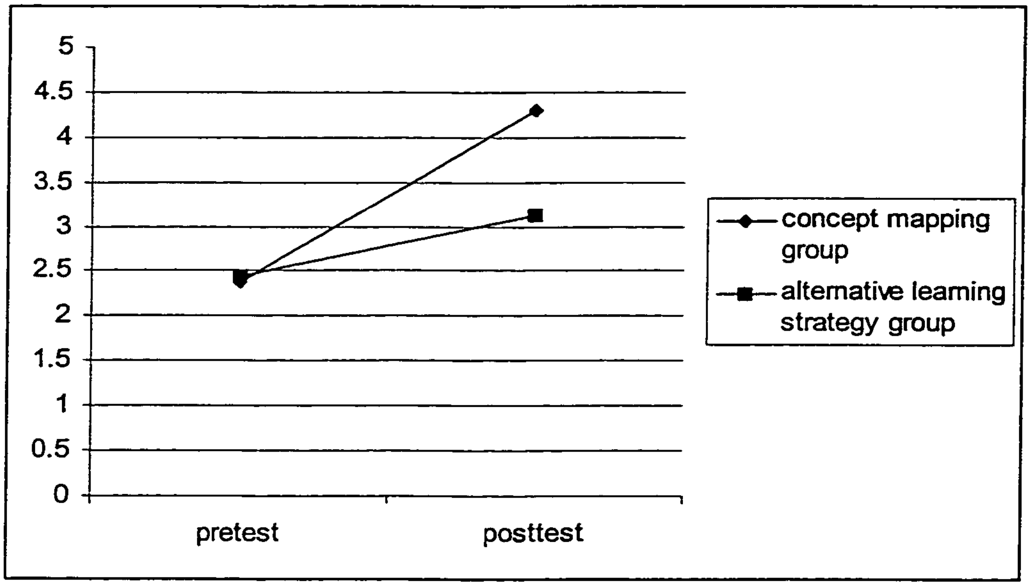


Figure 6. Interaction of time and method of instruction for self-monitoring data.

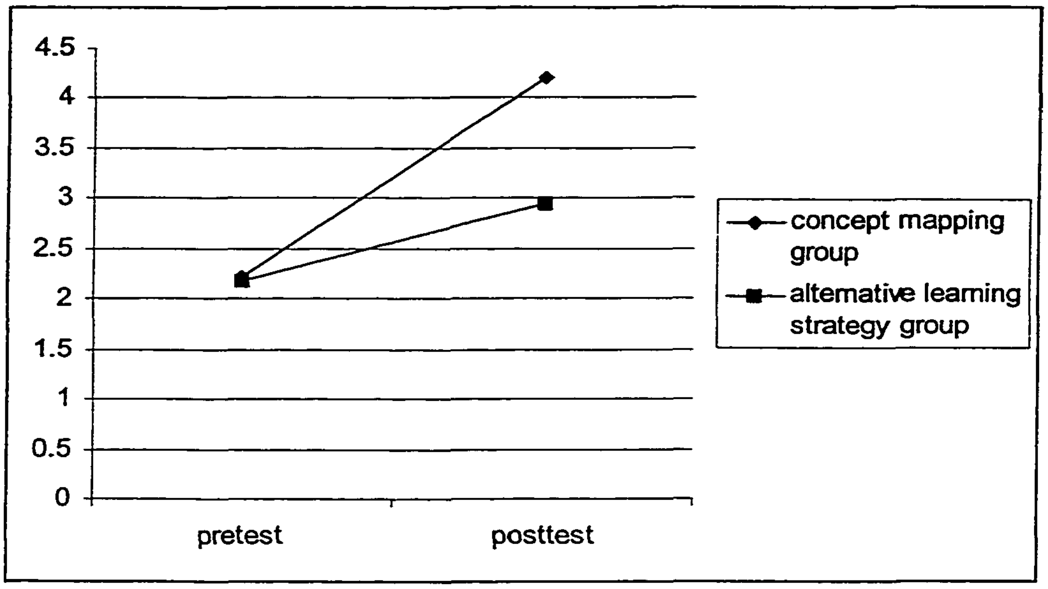


Figure 7. Interaction of time and method of instruction for knowledge acquisition strategy data.

Regarding the self-efficacy variable, there was a significant interaction but the partial eta squared suggests little practical difference (small effect size). Figure 8 indicates that the students in the concept mapping group showed a slightly greater increase on self-efficacy than the students in the alternative learning strategy group.

These findings support the prediction that the students in the concept mapping group would show significantly greater increases on self-monitoring, knowledge acquisition strategies, and self-efficacy than would students in the alternative learning strategy group.

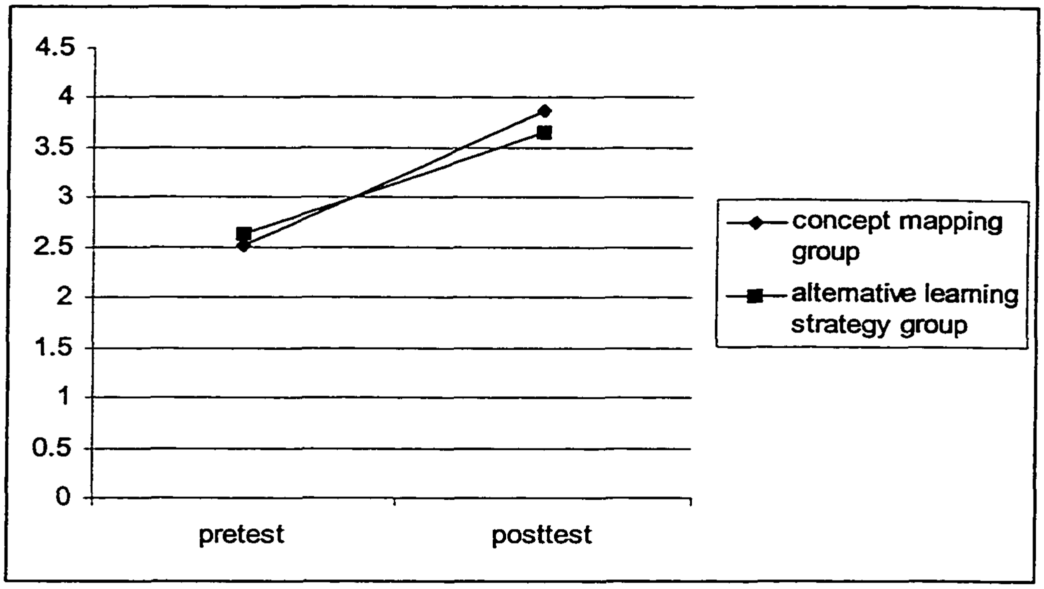


Figure 8. Interaction of time and method of instruction for self-efficacy data.

CHAPTER FIVE

DISCUSSION

This chapter has four major sections. The first section presents a summary of findings. The second section will focus on a discussion of the learning strategy effects that concept mapping has on achievement. The third section of this chapter will focus on a discussion of the effects that concept mapping has on self-regulation (self-monitoring and knowledge acquisition strategies). The fourth section will focus on a discussion of the effects that concept mapping has on self-efficacy. Finally, in the last section, a brief discussion of the implications for practice and directions for future research is presented.

Summary of the Findings

The statistically significant interaction of time and method of instruction for achievement, self-monitoring, knowledge acquisition strategy, and self-efficacy were found. For all variables, the concept mapping group showed significantly greater gains from pre-test to post-test than the alternative learning strategy group. Therefore, all three hypotheses were accepted in this study.

Another way to summarize the interaction effects is in terms of the variance accounted for (Partial eta squared) by the statistically significant effects. One important finding is that the interaction of time and method of instruction accounted for a large percentage of the variance in the achievement, self-monitoring, knowledge acquisition strategy, and self-efficacy scores. Specifically, the interaction of time and method accounted for forty two percent of the variance in achievement scores. For the learning behaviors measures, the interaction of time and method accounted for seventy-one percent of the variance in the self-monitoring scores, fifty-one percent of the variance in the knowledge acquisition strategy scores, and eighteen percent of the variance in the self-efficacy scores. Across the study, these findings favored the concept mapping strategy. They support the predictions that students in the concept mapping condition would outperform students in the alternative learning strategy condition on achievement, self-monitoring, knowledge acquisition strategies, and self-efficacy. In the next section, possible explanations for the group differences in the scores will be discussed.

Discussion of Findings Related to Achievement

The major issue addressed in this study was whether the use of the concept mapping strategy could assist ESL students' learning from text. Experimental data obtained in the study confirmed the existence of such an effect. The experimental group involved in concept mapping was found to have significantly greater achievement gains than the alternative learning strategy group in the achievement test. This is in accord with the findings of previous studies (Novak, Gowin & Johansen, 1983; Ault, 1985; Lehman, Carter & Kahle, 1985; Okebukola, 1986; Fraser & Edwards, 1987; Williams, 1997), which provided evidence that concept mapping is an effective tool for learning.

There are several possible explanations for the beneficial effects of the concept mapping in this study. First, research indicates that concept mapping strategy promotes meaningful learning (Williams, 1997). To learn meaningfully, individuals must choose to relate new knowledge to relevant concepts and propositions that they already know (Ausubel, 1963). Students in the concept mapping group may have more opportunities to create meaningful connections between concepts and use that knowledge to understand the reading passages than students in the alternative learning strategy group. For instance, when students were asked to read the "Wright Brothers Reading Passage," students may have used their prior knowledge about the meaning or the concepts of airplane, pilots, and aircraft to learn new vocabulary such as gliders and manned flight, and to understand the passage. Remembering words from prior experience may activate relevant schemata, which provides a framework for understanding the meaning of the reading passage. This explanation is consistent with the arguments of Lipson (1995) regarding the importance of prior knowledge in facilitating reading comprehension. Thus, when students use background knowledge related to the reading passage, they can understand it and learning takes place (Antonacci, 1991).

Second, concept mapping is a tool for presenting the interrelationships among concepts in an integrated, and hierarchical manner (Novak, 1981). The construction of concept maps may help the students to build more complex cognitive structures. The students would have been able to see the concepts do not exit in isolation. Each concept depends upon its relationships to many others for meaning. The students may also be able to understand not only the ideas/concepts, but the relationships between the ideas from the reading passage. For example, in the student's concept map of the "British Coral Reading Passage" (see Appendix G), the concepts of *Alcyonium digitatum*, *Lophelia pertusa,* and *Eunicella verucosa* have become understood within a network of other concepts from the concept map. It would seem that concept mapping allowed the student to indicate clearly the relative importance of each idea/concept and helped students perceive more clearly the organization of their reading material. It also may allow the student to figure out the links among the key ideas more easily, and to add in new information. Importantly, it may make it easier for student to see information in different ways, from different viewpoints, because it does not lock it into specific positions. This explanation is similar to Stice and Alvarez's (1987) study. They noted that concept mapping helped students to make sense of the material. Concept mapping helped students learn how they learned, and clarified connections between concepts by putting them on paper.

Concept mapping may also help identify hierarchical relationships among ideas. For example, in the student's concept map (see Appendix G), the more general, more inclusive concepts such as British Corals, Hard Corals, and Soft Corals were placed at the top of the map, and progressively more specific, less inclusive concepts such as Carpet coral, Cup coral, and Octo-corals were arranged below them. This may help to make the information more meaningful to students and they may have better understanding of reading. Moreover, concept mapping exercises may require the students to think in multiple directions and to switch back and forth between different levels of abstractions (Okebukola, 1990). In the present study, the students were seen to move a particular concept or sub-concept or idea from one section of the concept map to another until an appropriate location reflecting its correct position on the map was obtained. This procedure demanded that students have a good knowledge of the nature and attributes of the ideas/concept before locating it in the appropriate place on the map. This procedure also enabled the students to appreciate the interrelationships among the concepts and sub-concepts. Thus, the superior performance of the concept mapping group students over the alternative learning strategy group may be a result of these demands of the concept mapping strategy.

Finally, another possible explanation for the superior performance of the concept mapping group is that the act of creating the concept map may simply have served to focus students' attention on relevant reading passage (Lipson, 1995). It is possible that the concept mapping strategy keeps students focused on their task so that they may assimilate more information.

In the present study, the findings indicated improved performance by students who were trained in the concept mapping strategy. These findings support the contention that the process of concept mapping is likely to facilitate reading comprehension, since concept mapping requires semantic involvement with the text, attention to text structure, and the transformation of prose into a diagrammatic representation (Peresich, Meadows, & Sinatra, 1990; Sheldon, 1984; Reutzel, 1985; Armbruster & Anderson, 1980; Ruddell & Boyle, 1989; Briscoe & LaMaster, 1991).

In addition, engaging in the concept mapping activity assists students in learning how to learn. The concept mapping may encourage students to engage in self-regulatory processes because concept mapping makes explicit learners' opportunity to monitor, to control and to direct their own learning. In turn, students' study skills and academic self-regulation may be fostered. The possible explanations for this will be discussed in the next section.

Discussion of Findings Related to Self-Regulation (Self-Monitoring, Knowledge Acquisition Strategies)

Helping students to become self-regulated learners is important in academic settings. Learning to self-regulate their behaviors allows students to become more independent. Perhaps what is most important is that self-regulation strategies enable students to monitor and to regulate their own academic performance (Harris & Graham, 1992). In the present study, self-regulation involved the students' self-monitoring and use of knowledge acquisition strategies. This showed the extent to which students could use the strategies for studying, how well they understood the ideas/concepts they were studying, and how often they checked and corrected their understanding of these ideas/concepts.

Concept mapping activities may contribute to the learning process by involving four basic components of self-regulation (goal-setting, self-observation, self-judgment, and self-reaction). However, self-observation (or self-monitoring) may be most related to concept mapping because mapping encourages the students to be observers of their own learning. Moreover, knowledge acquisition strategies may also be utilized in the learning. For this reason, self-monitoring (or self-observation) and knowledge acquisition strategies aspects of self-regulation were investigated in the study.

As predicted, the findings showed that students in the concept mapping group showed significantly greater gains on self-monitoring and knowledge acquisition strategies than students in the alternative learning strategy group. A theoretical explanation for these findings is as follows. According to Schunk and Zimmerman (1994), self-regulation refers to students' ability to understand and control their learning. The basic goal for any self-regulation procedure is independent performance because students need to learn how to direct and manage their own learning. Students who are self-regulated are more likely to use effective learning strategies, to be meaningfully engaged in their own learning, and to attain their academic goals (Schunk, 1991). In the present study, the students may have become self-regulated learners because they served as the active ingredient in their learning. Constructing a concept map may force students to think about their own thinking on a reading passage (metacognition). It may require less teacher assistance and provide students with a sense of control over their learning outcomes. The students might have opportunities to monitor, evaluate, and adjust their understanding of reading passage through creating the concept maps.

Bandura (1986) stated that people use self-regulatory strategies such as goal setting, self-observation, self-judgment, and self-reaction to help them accomplish specific tasks. In this study, these four self-regulatory processes were used to explain how self-monitoring was enhanced when the concept mapping strategy was provided. First, the students may use goal setting to organize and to direct their learning. For instance, the students may enter the concept mapping activities with the goal of integrating concepts/ideas in a hierarchical manner. While working on concept maps, the students may observe: (a) whether their concept maps were developed in an appropriate direction, (b) whether the ideas/concepts were integrated in a hierarchical manner, and (c) whether the concepts/ideas were placed correctly. The students may also ask themselves whether they were paying attention during the concept mapping activity or they may count how many ideas/concepts they understood and included correctly in their concept maps. By investigating concept maps, the students might know how much they understood the information from a reading passage. In other words, concept mapping may present a clear picture of what students were learning and errors in learning would be more obvious. Construction of the concept maps may enable students not only to understand the ideas/concepts, but also to comprehend how main ideas and supporting details are related. Thus, this self-monitoring helps students to determine whether a target behavior has or has not occurred (Schunk, 1997).

After self-observation, the students may begin to judge and evaluate their own concept maps based on the standards or the goals they hold for themselves. If they judge their performance as progressing toward their goal, the students will continue to complete their concept maps. In contrast, if there are problems achieving their goal, the students will make revisions on their concept maps.

Finally, the last component of the self-regulation process is self-reaction. During this part of the regulatory process, students who judged their learning progress as inadequate may react by seeking further information or asking for assistance. On the other hand, the students who felt satisfied/gratified with their concept maps may be motivated to use concept mapping as a learning strategy in other classes.

In addition, as mentioned earlier, knowledge acquisition strategies may also be utilized during work on concept maps, because the students in the concept mapping group showed significantly greater scores on knowledge acquisition strategies than the students in the alternative learning strategy group. Concept mapping may assist students in acquiring structural knowledge by depicting the hierarchical relationships between concepts and clarify meanings of words by relating newly learned words to prior knowledge. For example, the students may tie together the ideas or concepts when they read a passage. When reading a passage, the students may also learn new ideas/concepts by relating the characteristics of the new ideas/concepts with similar concepts that they already learned. The greater improvement on knowledge acquisition of the concept mapping group students over the alternative learning strategy group may be a result of these demands of the concept mapping strategy. This finding concurs with the results demonstrated by Heinze-Fry and Novak (1990), in which concept mapping assists in integrating concepts, organizing material, and increasing retention and comprehension. Concept mapping required the learner to taking an active role in learning rather than being a passive recipient of knowledge. Participants who used concept mapping reported that the concept mapping strategy helped them understand the material, clarified relationships between concepts, and decreased the amount of time they spent memorizing content (Heinze-Fry & Novak, 1989). Novak (1989) also stated that learners can use concept maps as a learning strategy to promote acquisition of structural knowledge.

Generally speaking, these findings support the self-regulation theory and research on the benefits of concept mapping strategy. The concept mapping strategy may assist students in becoming more aware of their own learning. Therefore, students' uses of self-regulatory strategies (self-monitoring and knowledge acquisition strategies) in learning may be increased. Furthermore, in involving self-regulation processes, the students' self-efficacy may be increased. The next section will discuss the effects that concept mapping has on self-efficacy.

Discussion of Findings Related to Self-Efficacy

It was hypothesized that self-efficacy would be influenced by concept mapping training. The statistically significant interaction of time and method of instruction for self-efficacy indicated that the concept mapping group had greater gains in self-efficacy than the alternative learning strategy group. Thus this hypothesis was accepted. The possible explanations for this finding are as follows.

First, learning a language is a cognitively complex task. Learners must be able to handle a certain amount of ambiguity and be able to face difficult challenges. According to Bandura's social cognitive theory (1986), self-efficacy refers to the degree to which an individual possesses confidence in his or her ability to achieve a special goal. Self-efficacy beliefs influence the choices people make and the courses of action they pursue. Individuals tend to engage in tasks about which they feel competent and confident and avoid those in which they do not.

In this study, for example, students may enter the concept mapping activities with the goal of integrating concepts/ideas in a hierarchical manner. Creating the concept map may help students get through this challenging task because the steps in developing concept maps are easy to follow. Concept maps can also clearly illustrate what ideas/concepts from the text have been presented or omitted. Then, a concrete visual of understanding may occur. Because of these comprehensive procedures, the students may believe concept mapping is a useful strategy for assisting them in learning from text. This is consistent with Schunk's (1989) study that reported that students who believed they were learning a useful strategy were apt to feel efficacious about improving their writing and motivated to apply the strategy. Thus, having access to the concept mapping strategy may have led students to hold higher expectations of learning success.

In addition, when reading a passage, the students may have used self-monitoring and knowledge acquisition strategies to help them to develop a meaningful concept map. This concept map may present meaningful relationships between ideas/concepts in the form of propositions. Finally, as students gained proficiency in reading the passages, then the students' self-efficacy may be improved. Similarly, Barnhardt (1997) reported that student interest and motivation in a subject is often fostered when one understands the reading assignments.

In this study, concept map construction was taught by the experimenter who could provide the students feedback until the concept mapping strategy was mastered. The quality and organization of the information was considered much more important than the quality of the drawing itself. When the students were familiar with the demands of concept mapping activity, they may have experienced a sense of self-efficacy. In other words, mastering concept mapping may promote in students a sense of self-efficacy about their ability to understand the text.

This finding is supported by previous research. In Barnhardt's (1997) study, students who reported using a greater frequency of strategies perceived themselves as more confident in their language learning abilities. Schraw and Brooks (1999) also said that as strategy instruction increases, students become more self-efficacious. Moreover, Schunk (1989) and Pajares (1996) reported that students with high self-efficacy were more likely to use a broader array of strategies, to use them more flexibly, to monitor their comprehension better, and to process information at a deeper level (i.e., to generate important inferences about the material).

The information from this study provides incentive for ESL teachers to teach and promote the use of concept mapping strategy in the classroom as a way of increasing students' self-efficacy. When students know how to use the concept mapping strategy, their subsequent use of self-regulation in learning may increase and then self-efficacy is further promoted by the self-regulation processes.

<u>The Strength and Limitations of the Study</u>

Several methodology issues are important. The strength of the present study is that it is a randomized pretest-posttest control group design. This design is considered a true experimental design. The essential ingredient of a true experimental design is that subjects are randomly assigned to treatment groups. Random assignment is a powerful technique for controlling the subject characteristics threat to internal validity, a major consideration in educational research. In addition, the trained instructor who has taught English at CESL for many years conducted formal presentations and lessons. Both the researcher and the trained instructor also worked together in the classroom with the treatment groups to give individual feedback.

Regarding the limitations of the study, the present study did not include a large number of participants, since there were only eighty-two ESL students who were studying during the data collection period. However, based on the power analysis, the sample size was large enough to detect medium-sized effects and, in fact, significant effects were found.

<u>Implications for Practice</u>

The findings clearly demonstrate that a concept mapping can benefit ESL students. Table 2 shows a remarkable difference in the means of concept mapping and alternative learning strategy groups. This translates to effect sizes of very high magnitude whose practical significance is worth comment. In practical terms, the magnitude of its effect size would seem to suggest that concept mapping is a potent learning strategy available for CESL teachers for enhancing ESL students' understanding from text. Concept mapping has unique and potentially beneficial characteristics. They are concise, visual ways of representing concepts and their interrelationships. Additional benefits include that students are not constrained by particular time limits or proficiency in writing, they are allowed to be creative, and they can show their full range of knowledge

(Rafferty & Fleschner, 1993). Concept mapping is a student-directed strategy. The procedure does not interfere with teachers' lessons or require constant teacher involvement in managing students' inattentive behaviors. Another implication is that the ESL students may use concept maps to help tie previous experience and knowledge to the reading at hand, to summarize their thoughts during reading, and to organize recall of specific text details and difficult vocabulary.

This strategy is time efficient in that a great deal of preparation is not necessary, once the procedure has been used with one student the instructions can be used with others. Opportunities should also be given for the continuous review of the strategy with a view to improving on it and sharpening its potency.

Future Research

The results from this study are encouraging for the future development of concept mapping instruction with ESL students. There needs to be further research with this population because the present study was conducted outside a regular classroom during the students' lunch times. In order to get the best results, future research should be conducted in an actual classroom setting. Furthermore, this study did not provide extensive measures of maintenance over a long period of time. Although positive maintenance effects of concept mapping with students have been noted, future research should measure the long- term effects of this strategy for ESL students. Future research should also explore the effects of allowing students to generate their own concept maps individually, in groups, and as a class in their ESL reading class.

Little research has examined the influence of concept mapping on self-regulation and self-efficacy variables. This research needs to be replicated with different content areas and different instructional settings, particularly, elementary school, high school, and college settings. Moreover, in order to fully assertain the benefits of concept mapping strategy, this study needs to be investigated with international students with different cultural backgrounds, such as, Japanese, Thai, and Taiwanese students in their classroom settings. The research studies may show the interesting results.

Conclusion

Although semantic mapping strategy has been used in English as a Second Language classrooms, the present study used the concept mapping strategy to assist ESL students in learning from text. According to the results, concept maps were a good way for students to find the key ideas/concepts and principles in reading passages in constructing concept maps. The construction of the concept map requires considerable creativity in organizing the structure of the map, in selecting important, relevant concepts to add to the map and in searching out salient cross-links, indicating relationships between concepts in different sections of the map. Needless to say, the concept map becomes an important learning experience for the ESL students. The students learned how to learn because concept mapping required students to connect new information to prior knowledge. Concept map promotes meaningful learning rather than rote learning. Because the concept mapping procedure requires the learner to think in multiple directions, this procedure requires that the learner have a deep understanding of the material (Rafferty & Fleschner, 1993). Thus, in the present study, the concept mapping group students had better understanding of reading passages than the alternative learning strategy group students. They may also reduce or eliminate the need for rote learning.

Beside the cognitive benefits of concept mapping training, instruction in how to use concept mapping strategy was also related to gains in self-monitoring, knowledge acquisition strategies and self-efficacy.

References

Anderson, J. R. (1980). Cognitive psychology and its implications. New York: W.H. and company.

Antonacci, P. A. (1991). Students search for meaning in the text through semantic mapping. Social Education, 55 (3), 174-175.

Armbruster, B. B., & Anderson, T. H. (1980). The effect of mapping on the free recall of expository text (Technical Report No. 160). Washington, D.C.: National Institute of Education. (ERIC Document Reproduction Service No. ED 182 735)

Ault, C. R. (1985). Concept mapping as a study strategy in earth science. Journal of College Science Teaching, 15 (1), 38-44.

Ausubel, D. P. (1963). The psychology of meaningful verbal learning. New York: Grune and Stratton.

Ausubel, D. P. (1978). Educational psychology: A cognitive view. New York: Holt, Rinehart & Winston.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review, 84, 191-215.

Bandura, A. (1982). Self-efficacy mechanism in human agency. American Psychologist, 37, 122-147.

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1989). Human agency in social cognitive theory. American Psychologist, 44, 1175-1184.

Barenholz, H. & Tamir, P. (1987). The design, implementation and evaluation of microbiology course with special reference to misconception and concept maps. Proceedings of the Second International Seminar: Misconceptions and Educational Strategies in Science and Math Education, 1, 32-45.

Barnhardt, S. (1997). Self-efficacy and second language learning. The NCLRC Language Resource, 1 (5).

BBC Wildlife Magazine, February (1999), 19(3). Division of BBC Worldwide Publishing. BBC Worldwide Ltd. London.

Betz, N. E., & Hackett, G. (1983). The relationship of mathematics self-efficacy expectations to the selection of science-based college majors. Journal of Vocational Behavior, 23, 329-345.

Beyerbach, B. A., & Smith, J. M. (1990). Using a computerized concept mapping program to assess preservice teachers' thinking about effective teaching. Journal of Research in Science Teaching, 27 (10), 961-971.

Borkowski, J. G., Carr, M., Rellinger, E. A., & Pressley, M. (1990). Self-regulated strategy use: Interdependence of metacognition, attributions, and self-esteem. In B.F. Jones (Ed.), Dimensions of thinking: Review of Research, 53-92. Hillsdale, NJ: Erlbaum.

Bloom, B.S. (1956). Taxonomy of educational objectives: The classification of educational goals. Handbook I-Cognitive domain. New York: McKay.

Briscoe, C., & LaMaster, S., U. (1991). Meaningful learning in college biology through concept mapping. The American Biology Teacher, 53, 214-219.

Butler, L., D. (1997). The roles of goal setting and self-monitoring in students' self-regulated engagement in tasks. Paper presented at the Annual Meeting of the American

Educational Research Association, Chicago, Il. (ERIC Document Reproduction Service No. ED 409 323)

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: a theoretical synthesis. Review of Educatioal Research, 65, 245-281.

Carrell, P. L., & Pharis, B. & Liberto, J. (1989). Metacognitive strategy training for ESL reading. TESOL Quartery, 23 (4), 647-678.

Chaffee, J. (1985). Thinking critically. Boston: Houghton-Mifflin.

Carno, L. (1986). The metacognitive control components of self-regulated learning. Contemporary Educational Psychology, 11, 333-346.

Carno, L., & Mandinach, E., B. (1983). The role of cognitive engagement in classroom learning and motivation. Educational Psychologist, 18, 88-108.

Doring, A., Bingham, B., & Bramwell-Vial, A. (1997). Transition to university-a self-regulatory approach. Paper presented at the Annual Conference of the Australian Association for Research in Education. Brisbane, Australia, November 30 - December 4, 1997.

Douglas, C., M. (1997). Concept mapping: Foundations, research, and implications for hypermedia/multimedia design. Paper presented at ED-MEDIA 97—World Conference on Educational Multimedia and Hypermedia, Calgary, Canada.

Edmondson, K. M., & Smith, D., F. (1996). Concept mapping to facilitate veterinary students' understanding of fluid and electrolyte disorders. Paper presented at the Annual Meeting of the American Educational Research Association.

Feldsine, J. E., Jr. (1987). Distinguishing student misconceptions from alternate conceptual frameworks through the construction of concept maps. Proceedings of the

Second International Seminar: Misconception and Educational Strategies in Science and Math Education, 1, 177-181.

Fraser, K., & Edwards, J. (1987). The effects of training in concept mapping on student achievement in traditional tests. Research in Science Education, 15, 158-165.

Frayer, D. A., Fredrick, W. C. & Klausmeier, H. J. (1969). A schema for testing the level of concept mastery (Working Paper No. 16). Madison, WI: Wisconsin Research and Development Center for Cognitive Learning.

Graham, S., Harris, K. R., & Reid, R. (1992). Developing Self-Regulated Learners. Focus on Exceptional Children, 24, 1-16.

Hanf, M. B. (1971). A technique for translating reading into thinking. Journal of Reading, 14, 225-230.

Harris, K. R., & Graham, S. (1992). Self-regulated strategy development: A part of the writing process. In M. Pressley, K. R. Harris, & J. Guthrie (Eds). Promoting academic competence and literacy: Cognitive research and instructional innovation. New York: Academic Press.

Heinze-Fry, J. A., & Novak, J. D. (1990). Concept mapping brings long-term movement toward meaningful learning. Science Education, 74, 461-472.

Jegede, O. J., Alaiyemola, F., F., & Okebukola, P. A. (1990). The effect of concept mapping on students' anxiety and achievement in biology. Journal of Research in Science Teaching, 27 (10), 951-960.

Jonassen, D. H., Yacci, M., & Beissner, K. (1993). Structural knowledge: Techniques for representing, conveying, and acquiring structural knowledge. Hillsdale, NJ: Erlbaum.

Kaufman, M. (1992). Enhancing reading comprehension and critical thinking skills of first grade ESOL students through the use of semantic webbing. (ERIC Document Reproduction Service No. ED 345-579)

Kim, Y. S., German, P., & Patton, M. (1998). Preservice secondary science teachers' conceptions of the nature of science : By investigating their concept maps and final reflection paper. Paper presented at the Annual Conference of the National Association for Research in Science Teaching. San Diego, CA.

Lehman, J.D., Carter, C.C., & Kahle, J.B. (1985). Concept mapping, Vee mapping, and achievement: results of a field study with black high school students. Journal of Research in Science Teaching, 22 (7), 663-673.

Lent, R. W., Lopez, F. G., & Bieschke, K. J. (1993). Mathematics self-efficacy: sources and relation to science-based career choice. Journal of Counseling Psychology, 38, 424-430.

Lipson, M. (1995). The effect of semantic mapping instruction on prose comprehension of below-level college readers. Reading Research and Instruction, 34(4), 367-378.

Lloyd, C., V. (1990). The elaboration of concepts in three biology textbooks: facilitating student learning. Journal of Research in Science Teaching, 27 (10), 1019-1032. .

Malone, J., & Dekkers, J. (1984). The concept map as an aid to instruction in science and mathematics. School Science and Mathematics, 84 (3), 220-231.

McCombs, B. L. & Marzano, R. J. (1990). Putting the self in self-regulated learning: The self as agent in integrating will and skill. Educational Psychologist, 25(10, 51-69.

McKeachie, W. J., Pintrich, P. R., & Lin, Y., G. (1985). Teaching learning strategies. Educational Psychologist, 20 (3), 153-160.

Miller, R. B., Green, B. A., Montalvo, G. P., Ravindran, B., & Nichols, J. D. (1996). Engagement in academic work: The role of learning goals, future consequences, pleasing others, and perceived ability. Contemporary Educational Psychology, 21, 388-422.

Miller, L. D., & Perkin, K. (1989). ESL reading comprehension instruction. . (ERIC Document Reproduction Service No. ED 303 779)

Moreira, M. A. (1979). Concept maps as tools for teaching. Journal of College Science Teaching, 8 (5), 283-286.

Nelson, R., O. (1977). Methodological issues in assessment via self-monitoring. In J. D., Cone & R. P. Hawkins (Eds.), Behavioral Assessment: New directions in clinical psychology. New York: Brunner/Mazel.

Novak, J. D. (1976). Understanding the learning process and effectiveness of teaching methods in the classroom laboratory, and field. Science Education, 60(4), 493-512.

Novak, J. D. (1977). An alternative of Pigetian psychology for science and mathematics education. Science Education, 61 (4), 453-477.

Novak, J. D. (1979). Applying psychology and philosophy to improvement of laboratory teaching. The American Biology Teacher, 41 (8), 466-470.

Novak, J. D. (1981). Applying learning psychology and philosophy of science to biology teaching. The American Biology Teacher, 43 (1), 12-20.

Novak, J. D. (1984). Learning how to learn. Cambridge, England: Cambridge University Press.

Novak, J. D. (1987). Human constructivism: Toward a unity of psychological and epistemological meaning making. In J. D. Novak (Ed.), Second international seminar on misconceptions and educational strategies in science and mathematics, 1 (349-360). Ithaca, NJ: Department of Education, Cornell University.

Novak, J. D. & Gowin, D. B (1984). Concept mapping for meaningful learning. Learning how to learn. Cambridge: Cambridge University Press, 15-54.

Novak, J. D., Gowin, B., & Johansen, G. T. (1983). The use of concept mapping and knowledge Vee mapping with junior high school science students. Science Education, 67 (5), 625-645.

Okebukola, P. A. (1986). Influence of preferred learning styles on cooperative learning in science. Science Education, 70, 65-74.

Okebukola, P. A. (1990). Attaining meaningful learning of concepts in genetics and ecology: An examination of the potency of the concept-mapping technique. Journal of Research in Science Teaching, 27 (5), 493-504.

Okebukola, P. A., & Jegede, O. J. (1988). Cognitive preference and learning mode as determinants of meaningful learning through concept mapping. Science Education, 72 (4), 489-500.

Okebukola, P. A., & Jegede, O. J. (1989). Students' anxiety towards and perception of difficulty of some biological concepts under the concept-mapping heuristic. Research in Science and Technological Education, 7 (1), 85-91.

O' Leary, S., & Dubey, D. (1979). Applications of self-control procedures by children. Journal of Applied Behavior Analysis, 12, 449-465.

Owings, R. A., & Peterson, G. A., Bransford, J. D., Morris, C. D., & Stein, B. S. (1980). Spontaneous monitoring and regulation of learning: a comparison of successful and less successful fifth graders. Journal of Educational Psychology, 72 (2), 250-256.

Pajares, F. (1996). Self-efficacy beliefs in academic settings. Review of Educational Research, 66, 543-578.

Pankratius, W. J. (1990). Building an organized knowledge base: Concept mapping and achievement in secondary school physics. Journal of Research in Science Teaching, 27 (4), 315-333.

Park, S. (1995). Implications of learning strategy research for designing computer-assisted instruction. Journal of Research on Computing in Education, 25(4), 435-456.

Peresich, M., Meadows, J., Sinatra, R. (1990). Content area mapping for reading and writing proficiency. Journal of Reading, 33 (6), 424-432.

Pintrich, P. R., Cross, D. R., Kozma, R. B., & McKeachie, W. J. (1986). Instructional psychology. Annual Review of Psychology, 37, 611-651.

Pintrich, P. R., & DeGroot, E.V. (1990). Motivational and self-regulated components of classroom academic performance. Journal of Educational Psychology, 82(1), 33-40.

Pressley, M. (1982). Elaboration and memory development. Child Development, 53, 296-309.

Pressley, M. (1986). The relevance of the good strategy user model to the teaching of mathematics. Educational Psychologist, 21, 139-161.

Rafferty, C. D. & Fleschner, L. K. (1993). Concept mapping: A viable alternative to objective and essay exams. Reading Research and Instruction, 32 (3), 25-34.

Reutzel, D. (1985). Story maps improve comprehension. Reading Teacher, 38(4), 400-411.

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 (1), 12-22.

Salam, A., & Koumy, A. (1999). Effects of three semantic mapping strategies on EFL students' reading comprehension. (ERIC Document Reproduction Service No. ED 435 193)

Schraw, G., & Brooks, D.W. (1999). Helping students self-regulate in math and sciences courses: improving the will and the skill. Educational Psychology Review, 15, 175-185.

Schunk, D. H. (1984). Self-efficacy perspective on achievement behavior. Educational Psychologist, 19, 48-58.

Schunk, D. H. (1985). Participation in goal setting: effects on self-efficacy and skills of learning disabled children. Journal of Special Education, 19, 307-317.

Schunk, D. H. (1986). Verbalization and children' s self-regulated learning. Contemporary Educational Psychology, 11, 347-369.

Schunk, D. H. (1989). Self-efficacy and achievement behaviors. Educational Psychology Review, 1, 173-208.

Schunk, D. H. (1990). Goal setting and self-efficacy during self-regulated learning. Educational Psychologist, 25, 71-86.

Schunk, D. H. (1991). Self-efficacy and academic motivation. Educational Psychology Review, 26, 207-231.

Schunk, D. H. (1994). Self-regulation of self-efficacy and attributions in academic settings. In D. H. Schunk & B. J. Zimmerman (Eds), Self-regulation of learning and performance: Issues and educational applications, 75-99, Hillsdale, NJ: Lawrence Erlbaum Associates.

Schunk, D. H. (1997). Self-monitoring as a motivator during instruction with elementary school students. (ERIC Document Reproduction Service No. ED 404 035)

Schunk, D. H., & Rice, J. M. (1999). Learning goals and children's reading comprehension. Journal of Reading Behavior, 21, 279-293.

Sharpe, J. P. (1999). Barron's practice exercises for the TOEFL test. Barrons Educational Audio; ISBN: 0812082729.

Sheldon, S., (1984). Comparison of two teaching methods for reading comprehension. Journal of Research in Reading, 7 (1), 41-52.

Starr, M. L., & Krajcik, J., S. (1990). Concept maps as a heuristic for science curriculum development: Toward improvement in process and product. Journal of Research in Science Teaching, 27 (10), 987-1000.

Stewart, J., Van Kirk, J., & Rowell. R. (1979). Concept maps: A tool for use in biology teaching. The American Biology Teacher, 41 (3), 171-175.

Stice, C. F. & Alvarez, M. C. (1987). Hierarchical concept mapping in the early grades. Childhood Education, 86-96.

Weinstein, C., E. (1988). Elaboration skills as a learning strategy. New York: Academic Press.

Weinstein, C. E., & MacDonald, J.D. (1986). Why does a school psychologist need to know about learning strategies. Journal of School Psychology, 24, 257-265.

Weinstein, C.E., & Mayer, R.E. (1986). The teaching of learning strategies. In M. Wittrock (Ed.), The handbook of research on teaching, 315-327. New York: Macmillan

Wallace, J. D., & Mintzes, J. J. (1990). The concept map as a research tool: Exploring conceptual change in biology. Journal of Research in Science Teaching, 27 (10), 1033-1052.

Williams, J. (1997). The relation between efficacy for self-regulated learning and domain-specific academic performance, controlling for test anxiety. Journal of Research and Development in Education, 29, (2), 77-80.

Willerman, M., & Mac Harg, R. A. (1991). The concept map as an advance organizer. Journal of Research in Science Teaching, 28 (8), 705-711.

Zimmerman, B. J. (1986). Development of self-regulated learning: Which are the key subprocesses? Contemporary Educational Psychology, 16, 307-313.

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. Journal of Educational Psychology, 81, 329-339.

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: an overview. Educational Psychologist, 25, 3-18.

Zimmerman, B. J., & Marinez-Pons, M. (1986). Development of structured interview for assessing student use of self-regulated learning strategies. American Educational Reseach Journal, 23, 614-628.

Zimmerman, B. J., & Marinez-Pons, M. (1988). Construct validation of a strategy model of student self-regulated learning. Journal of Educational Psychology, 80, 284-290.

Zimmerman, B. J., & Marinez-Pons, M. (1992). Student differences in self-regulated learning : relating grade, sex, and giftedness to self-efficacy and strategy use. Journal of Educational Psychology, 82, 51-59.

Zimmerman, B. J., & Schunk, D., H. (1989). Self-regulated learning and academic achievement: theory, research, and practice. Springer-Verlag New York Inc.

Zimmerman, B. J., Bandura, A., & Marinez-Pons, M. (1992). Self-motivation for academic attainment : The role of self-efficay beliefs and personal goal setting. American Educational Research Journal, 29, 663-676.

Appendices

Appendix A

Strategies for Introducing Concept Mapping to ESL Students

A. Activities to prepare for concept mapping. In order to prepare students to be familiar with the meanings of concepts, objects, events, and linking words, the following activities are provided.

1. Make two lists of words on the blackboard or overhead projector using a list of familiar words for objects and another list for events. For example, object words might be car, dog, chair, tree, cloud, book; and event words could be raining, playing, washing, thinking, thunder, birthday party. Ask students if they can describe how the two lists differ. Try to help them recognize that the first list is things or *objects* and the second list is happenings or *events,* and label the two lists.
2. Ask the students to describe what they think of when they hear the word car, dog, etc. Help them recognize that even though we use the same words, each of us may think of something a little different. These mental images we have for words are our *concepts*; introduce the word concept.
3. Repeat the activities in step 2, using event words. Again, point out the differences in our mental images, or concepts, of events. The teacher may want to suggest at this point that one reason we have trouble understanding each other sometimes is that our concepts are never quite identical even though we know the same words. Words are labels for concepts, but each of us must acquire our own meanings for words.
4. Now list words such as are, where, the, is, then, with. Ask students what comes to their minds when they hear each of these words. These are not concept words; we call them *linking* words and we use them in speaking

and writing. Linking words are used together with concept words to construct sentences that have meaning.

5. Proper nouns are not concept words but rather names of specific people, events, places, or objects. Use some examples and help students to see the distinction between labels for *regularities* in events or subjects and those for specific events or objects (or proper nouns).
6. Using two concept words and linking word (s), construct a few short sentences on the board to illustrate how concept words plus linking words are used by humans to convey meanings. Examples would be: The dog is running. Or, There are clouds and thunder.
7. Have the students construct a few short sentences of their own, identify the concept words and tell whether each is an object or event, and also identify the linking words.
8. Introduce some short but unfamiliar words to the class such as dire, terse, or *canis*. These are words that stand for concepts they already know, but have somewhat special meaning. Help students see that meanings of concepts are not rigid and fixed, but can grow and change as we learn more.
9. Choose a section of a textbook (one page is sufficient) and duplicate copies for the students. Choose a passage that conveys a definite message. As a class, ask them to read the passage and identify key concepts. (Usually 10 to 20 relevant concepts can be found in a single page of text

material). Also, have the students note some linking words and concept words that are less important to the story line.

B. Concept mapping activities

1. Select a particularly meaningful paragraph that is familiar to student from a text or other printed material. Have the students read the text and select the key concepts, that is, those concepts necessary for understanding the meaning of the text. List these concepts on the board as they are identified. Now discuss with the students which concept is the most important, most inclusive idea in the text.

2. Put the most inclusive concept at the head of a new list of rank-ordered concepts. List the next most general, most inclusive concepts, working through the first list until all concepts are rank ordered. There will not always be agreement among the students on the ordering, but usually only a few major differences in ranking of the concepts will arise. This is OK because it suggests that there may be more than one way to see the meaning of the text.

3. Now begin constructing a concept map, using the rank-ordered list as a guide in building the concept hierarchy. Have students help in choosing good linking words to form the propositions shown by the lines on the map.

4. Now look for cross links between concepts in one section of the map and concepts in another part of the concept "tree." Have students help to choose linking words for the cross links.

5. Most first effort maps have poor symmetry or some concept clusters poorly located relative to other more closely related concepts or clusters of concepts. Reconstruct the map if this would be helpful. Point out to students that at least one and sometimes two or three reconstructions of a map are needed to show a good representation of prepositional meanings as they understand them.
6. Now provide a reading passage to students and have them repeat steps 1-6 on their own.

After each student has constructed a map, it would be useful to have a "progress discussion" with the class:

a. Review with them the definitions of concept, object, events, linking words, proper nouns.
b. Discuss the idea that we learn best when we tie new concepts to concepts we already have.
c. Point out that hierarchically constructed maps help to subsume more specific concept meanings into larger, more general concepts.
d. Help them to see that cross links on their maps mean they are tying together concepts that might not otherwise be seen as related.
e. Discuss about concept mapping, rote learning, and meaningful learning.

Appendix B

Survey of Learning Behaviors

This survey is intended to provide an overview of your outlook on learning the material from ESL class. It will sample your behaviors and beliefs about learning/ studying. Please answer each question as honestly as you can. Your answers will not influence your grade in any way and they will be confidential. Read each question carefully. Answer to the questions along the following 5-point scale. Circle your answer on the line following the item.

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

(1) After reading a passage, I check my understanding by drawing a diagram..1 2 3 4 5

(2) I tie together the ideas when I read a passage..1 2 3 4 5

(3) I am confident that I can understand the information contained in a passage..1 2 3 4 5

(4) After reading, I organize the ideas to see what I know and what I don' t know about them..1 2 3 4 5

(5) I draw pictures or diagrams to help me understand the ideas from a reading passage..1 2 3 4 5

(6) I am certain I understand the ideas presented in a reading passage............1 2 3 4 5

(7) When reading, I connect ideas with each other to see if I understand them..1 2 3 4 5

(8) When reading, I learn new ideas by relating the characteristics of the new ideas with similar ideas that I already know.......................1 2 3 4 5

(9) When reading, I stop to ask myself whether or not I understand the ideas...1 2 3 4 5

(10) I think I am good at learning ideas (concepts) from a reading passage.....1 2 3 4 5

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

(11) After I finish a reading assignment, I look back to see if I am happy with my work.. 1 2 3 4 5

(12) I think I am doing better than other students at understanding passages...1 2 3 4 5

(13) When I read a passage I check to see that I understand it correctly.........1 2 3 4 5

(14) After I finish a reading assignment in my ESL class, I check to see if it is complete...1 2 3 4 5

(15) When I read a passage I take note of the ideas that have or have not learned...1 2 3 4 5

(16) I can understand the information (concepts) I have read in my ESL class.. 1 2 3 4 5

(17) To check if I understand the ideas from my reading, I link the new ideas to the ideas I have already learned.................................... 1 2 3 4 5

(18) I am certain I can do the reading assignment in my ESL class............ 1 2 3 4 5

(19) When reading, I can draw pictures or diagrams to help me understand the ideas (concepts)... 1 2 3 4 5

(20) When learning new ideas from a reading passage, I think of practical applications for them... 1 2 3 4 5

Appendix C

The Original 52 Achievement Items for the Pilot Study

The Pika Cycle Reading Passage:

1. The collection of food by Pikas occurs
   (a) just as the snow is melting.
   (b) during the late winter months.
   (c) after the babies are born.
   (d) with the new vegetation on the meadows.

2. Hungry predators lose opportunities to capture Pikas when
   (a) Pikas leave scent marks.
   (b) Pikas send warnings from Pika to Pika.
   (c) Pikas gather plants to make hay.
   (d) Pikas take advantage of territorial fights.

3. Fresh vegetation is mandatory for
   (a) pregnant females in the spring.
   (b) building nutritious haypiles.
   (c) females to put on protective fat.
   (d) females to wean their young successfully.

4. Which of the following topics does the passage concern?
   (a) The Pikas' child rearing.
   (b) The Picas' food collecting.
   (c) The Picas' feeding.
   (d) The Picas' annual activities.

5. What would happen if the Pikas have babies when the snow melts late?
   (a) The litter would be strong.
   (b) The litter would not survive.
   (c) The litter would need more care.
   (d) The litter would be lost.

6. When do the Pikas' mothers eat the new vegetation that grows around the mountain?
   (a) After weaning their babies.
   (b) After giving birth to their babies.
   (c) Before the coming winter.
   (d) During the rearing of their babies.

7. What do the Pikas do when they detect predators?
   (a) Give a repetitive short call to other Pikas.
   (b) Jump in front of their places.
   (c) Call their young.
   (d) Run around their tunnels.

8. Haypiles for each member of a new litter
   (a) are began as soon as the young are weaned.
   (b) must be completed before the first heavy snow.
   (c) are prepared by the adult male.
   (d) are not necessary until the next mating season.

9. Food collecting is dangerous for Pikas because
   (a) the Pikas are more likely to get lost when they are alone.
   (b) the Pikas are vulnerable to predators when they are out gathering food.
   (c) the Pikas are more likely to be sick when gathering food.
   (d) the Pikas are very weak while collecting food.

10. Why are the repetitive short calls important?
   (a) They are a deterrent to other animals who are hungry for the Pika as food.
   (b) They are a distraction used to control the young litter.
   (c) They are a signal of danger to other Pikas.
   (d) They are a territorial claim to property rights.

11. Scent marks are created by
   (a) Pikas when they rub their cheek glands on rocks.
   (b) distracted Pikas who are building haypiles.
   (c) females who have lost their young.
   (d) relaying warning calls from Pika to Pika.

The Horace Mann Reading Passage:

12. Which of the following describes Horace Mann' s early life?
   (a) He attended school six months a year.
   (b) He supported his family after his father died.
   (c) He was an only child.
   (d) He had to learn alone, without help.

13. Which of the following describes Horace Mann' s reforms?
   (a) They were not very radical for the time.
   (b) They were used only by the elementary schools.
   (c) They were later adopted by the nation as a model.
   (d) They were enforced by the Public school teachers.

14. Horace Mann was involved in the creation of normal schools for the purpose of
   (a) special education.
   (b) adult education.
   (c) all young children.
   (d) teaching teachers.

15. What is the meaning of "Be ashamed to die until you have won some victory for humanity."?
    (a) Do good works at least once in your life.
    (b) Life is shameful.
    (c) Mankind has lost the battle for ending suffering.
    (d) Indifference is shameful.

16. Horace Mann' s influence on American education was
    (a) very great.
    (b) small, but important.
    (c) misunderstood.
    (d) not accepted.

17. Horace Mann's ideas, that he wrote to the state of Massachusetts, later:
    (a) served as a model for American Public Education.
    (b) served as a model to reform special education.
    (c) served as a pattern for international school systems.
    (d) provided a great source for school rules.

18. What did Horace Mann advocate regarding American education?
    (a) The state board school system.
    (b) The district school system.
    (c) The substitute school system.
    (d) The graded school system.

19. Horace Mann was very interested in educating children of parents who worked:
    (a) on farms.
    (b) in inner cities.
    (c) in politics.
    (d) in legal jobs.

20. How were Mann's educational reforms distributed?
    (a) In twelve annual reports to the state of Massachusetts.
    (b) In reports that he wrote for national distribution.
    (c) In speeches that he made throughout the country.
    (d) In books that could be found in school libraries.

21. Which of the following titles would best express the main topic of the passage?
    (a) The Father of American Public Education
    (b) Philosophy of Education
    (c) The Massachusetts State Board of Education
    (d) Politics of Educational Institutions

22. Which of the following would encourage Horace Mann to work hard?
   (a) Lack of school attendance.
   (b) Lack of support from friends.
   (c) Inspiration from Mann's father.
   (d) Motivation provided by teachers.

The Wright Brothers Reading Passage:

23. In contrast to the Wright brothers, other engineers
   (a) experimented with flight theories.
   (b) experimented with different wing designs.
   (c) experimented with different steam engines.
   (d) experimented with many pilots.

24. What was the outcome of collecting the data from the wind tunnel experiments?
   (a) The Wright Brothers could construct a more effective wing for their craft.
   (b) The Wright Brothers became famous pilots.
   (c) The Wright Brothers knew nothing from their experiments.
   (d) The Wright Brothers leaned new knowledge but it was not related to their objectives.

25. Why was building and flying kites and gliders important?
   (a) It gave the Wright brothers opportunities to solve aircraft problems.
   (b) It provided the Wright brothers to solve the problem for take-off.
   (c) It made the Wright brothers work as a team.
   (d) It provided the Wright brothers opportunities to become famous pilots.

26. By experimenting with the combustion engine, the Wright brothers were able to
   (a) solve problem of take-off.
   (b) solve the landing problem.
   (c) solve the air pressure problem.
   (d) solve the ratio problem of the aircraft.

27. How did the Wright Brothers get their flight experience?
   (a) By reading books about the flight experience of others.
   (b) By attending a school for training aviators.
   (c) By building and improving kites and flying gliders.
   (d) By doing research about the flight.

28. What kind of experience did the Wright Brothers have that distinguished them from their competitors?
   (a) They were researchers.
   (b) They were glider pilots.
   (c) They were engineers.
   (d) They were inventors.

29. How did the Wright brothers build the wings for their airplanes?
(a) By copying the wings of gliders they had flown.
(b) By experimenting with different wing designs in a wind tunnel.
(c) By using wings that had been developed by other engineers.
(d) By collecting data from scientific literature.

30.What is the author' s main point in this passage?
(a) The reasons why the Wright brothers succeeded in manned flight.
(b) The advantage of the internal combustion engine in the Wright brothers' experiments.
(c) The Wright brothers' experience as pilots.
(d) The importance of gliders in the development of airplanes.

31. According to the Wright brothers, what was the most serious problem in constructing a manned aircraft?
(a) Achieving take-off.
(b) Constructing the wings.
(c) Controlling the aircraft.
(d) Controlling the engine.

32. What was the problem with the steam engines used in earlier aircraft?
(a) They were too small to power a large plane.
(b) They were too light to generate enough power.
(c) They did not have internal combustion power.
(d) They did not have enough power to lift their own weight.

The Acacia Trees Reading Passage:

33. Which of the following would most probably be made from a Black Acacia tree?
(a) flower arrangement
(b) table
(c) pie
(d) paper

34. Which of the following topics does the passage concern?
(a) The Black Acacia
(b) Characteristics and varieties of the Acacia
(c) Australian varieties of the Acacia
(c) The use of Acacia wood for ornamental furniture

35. Why do we use the Black Acacia in making pianos?
(a) Because it is a dark wood.
(b) Because it is a hard wood.
(c) Because it is a strong wood.
(d) Because it is a smooth wood.

36. The Golden Wattle differs from Blackwood because
   (a) Golden Wattle has flat leaves, but Blackwood has dark green leaves.
   (b) Golden Wattle has flat leaves, but Blackwood has black leaves.
   (c) Blackwood has dark green leaves, but Golden wattle has yellow leaves.
   (d) Blackwood has black leaves, but Golden Wattle has flat leaves.

37. Which of the following would most probably be used to decorate the house?
   (a) Bailey Acacia
   (b) Black Wood
   (c) Golden Wattle
   (d) Silver Wattle

38. According to the passage, the Golden Wattle
   (a) is squat and bushy.
   (b) has unobtrusive blossoms.
   (c) is taller than the Bailey acacia.
   (d) is used for making furniture.

39. Which of the following is the most showy of the Acacia trees?
   (a) The Bailey Acacia
   (b) The Silver Wattle
   (c) The Black Acacia
   (d) The Golden Wattle

40. Which of the following statements best describes the characteristics of Acacia?
   (a) Acacia will bloom in Winter in the Southern Hemisphere.
   (b) Acacia will bloom in Winter in the Northern Hemisphere.
   (c) Acacia will bloom in Summer in the Southern Hemisphere.
   (d) Acacia will bloom in Winter in both the Southern and the Northern Hemisphere.

41. What would happen if we cultivated Acacia in the Northern United States?
   (a) They would grow well.
   (b) They would have more flowers.
   (c) They would grow well but need more water.
   (d) They would not grow well.

42. How are the Bailey Acacia and Silver Wattle similar?
   (a) They are squat and bushy with broad, flat leaves.
   (b) They grow as the same height.
   (c) They have small, fernlike silver leaves.
   (d) They are used in making furniture.

The British Corals Reading Passage:

43. The polyps of all three types of coral are connected to
 (a) the tentacles.
 (b) the bony skeleton.
 (c) clusters of related corals.
 (d) a water column.

44. How are sea fan corals and soft corals are similar?
 (a) They are homes for many marine creatures.
 (b) They are joined by a thread of tissue at the base.
 (c) They have eight tentacles.
 (d) They have stony skeletons.

45. Polyps and tentacles, together, bear the main responsibility of
 (a) attacking predators.
 (b) forming colonies.
 (c) catching food.
 (d) protecting the colony.

46. Which of the following titles would best express the main topic of the passage?
 (a) The Characteristics of British Corals
 (b) The Type of Corals
 (c) The Characteristics of Solitary Corals
 (d) The Characteristics of Colony Corals

47. Sea fan corals and soft corals differ from hard corals in that they
 (a) are homes for many marine creatures.
 (b) joined by a thread of tissue at the base.
 (c) have stony skeletons.
 (d) have eight tentacles.

48. The coral which lives in the deepest areas of the North Sea is
 (a) "Deadman Fingers."
 (b) Sea Fan.
 (c) Cup coral.
 (d) a coral with no common name.

49. The substance called gorgonim is necessary in
 (a) the formation of the corals'sea fans.
 (b) forming slender colonies of coral.
 (c) fusing separate corals together.
 (d) attracting food to the coral.

50. What do hard, soft, and sea fans corals have in common?
   (a) They are all located just off the North Sea.
   (b) Their body types are similar.
   (c) Each type of coral species includes sea anemones.
   (d) Each coral' s mouth is surrounded by tentacles.

51. How do soft corals differ from hard coral?
   (a) They are found in deeper seabeds.
   (b) They are found in solitary units.
   (c). They have a gelatinous mass.
   (d). They resemble "fingers."

52. What makes cup corals different from carpet coral and the "rain forest of the sea"?
   (a) Cup corals are solitary.
   (b) Cup corals are a colony.
   (c) Cup corals grow in deep water.
   (d) Cup corals have a gelatinous mass.

Appendix D

Table of Item Difficulty for the Achievement Test

Table of Item Difficulty for the Achievement Test

Questions	Number of Correct Answers	Number of Wrong Answers
1	23	9
2 (removed item)	25	7
3	20	12
4	24	8
5	20	12
6	22	10
7 (removed item)	27	5
8	21	11
9 (removed item)	29	3
10 (removed item)	29	3
11	21	11
12 (removed item)	28	4
13	26	6
14 (removed item)	26	6
15	27	6
16 (removed item)	30	2
17	26	6
18	19	13
19 (removed item)	26	6
20 (removed item)	27	5
21	26	6
22	22	10
23	20	12
24	22	10
25	24	9
26 (removed item)	23	9
27	23	10
28 (removed item)	23	9
29	22	10
30 (removed item)	22	10
31	9	23
32	20	12
33 (removed item)	32	0
34 (removed item)	29	3
35	15	17
36	25	7
37 (removed item)	29	3
38 (removed item)	25	7
39 (removed item)	25	7
40	18	13
41	23	9

42	20	12
43 (removed item)	24	8
44	21	11
45	11	21
46	20	12
47 (removed item)	24	8
48	21	11
49	19	13
50	24	8
51 (removed item)	26	6
52	20	12

***These 52 items were used in the pilot study.

Appendix E

Achievement Test in the Main Study

Reading Passages

<u>Directions:</u> In the rest of this section you will read several passages. Each one is followed by several questions about it. For questions 1- 33, you are to choose the one best answer, (a), (b), (c), or (d), to each question. Then, on your answer sheet, find the number of the question and fill in the space that corresponds to the letter of the answer you have chosen.

Answer all questions following a passage on the basis of what is <u>stated</u> or <u>implied</u> in that passage.

Read the following passage: <u>(Question 1-6)</u>

Perhaps it was his own lack of adequate schooling that inspired Horace Mann to work so hard for the important reforms in education that he accomplished. While he was still a boy, his father and older brother died, and he became responsible for supporting his family. Like most of the children in his town, he attended school only two or three months a year. Later, with the help of several teachers, he was able to study law and become a member of the Massachusetts bar, but he never forgot those early struggles.

While serving in the Massachusetts legislature, he signed a historic education bill that set up a state board of education. Without regret, he gave up his successful legal practice and political career to become the first secretary of the board. There he exercised an enormous influence during the critical period of reconstruction that brought into existence the American graded elementary school as a substitute for the older district school system. Under his leadership, the curriculum was restructured, the school year was increased to a minimum of six months, and mandatory schooling was extended to age sixteen. Other important reforms included the establishment of state normal schools for teacher training, institutes for inservice teacher education, and lyceums for adult education. He was also instrumental in improving salaries for teachers and creating school libraries.

Mann's ideas were developed and distributed in twelve annual reports to the state of Massachusetts that he wrote during his tenure as secretary of education. Considered quite radical at the time, the Massachusetts reforms later served as a model for the nation. Mann was recognized as the father of public education.

During his lifetime, Horace Mann worked tirelessly to extend educational opportunities to agrarian families and the children of poor laborers. In one of his last speeches he summed up his philosophy of education and life: "Be ashamed to die until you have won some victory for humanity." Surely, his own life was an example of that philosophy.

1. Which of the following describes Horace Mann's reforms?
   (a) They were not very radical for the time.
   (b) They were used only by the elementary schools.
   (c) They were later adopted by the nation as a model.
   (d) They were enforced by the public school teachers.

2. What is the meaning of "Be ashamed to die until you have won some victory for humanity"?
   (a) Do good works at least once in your life.
   (b) Life is shameful.
   (c) Mankind has lost the battle for ending suffering.
   (d) Indifference is shameful.

3. Horace Mann's ideas, that he wrote to the state of Massachusetts, later
   (a) served as a model for American public education.
   (b) served as a model to reform of special education.
   (c) served as a pattern for international school systems.
   (d) provided a source for school rules.

4. What did Horace Mann advocate regarding American education?
   (a) The state board school system.
   (b) The district school system.
   (c) The substitute school system.
   (d) The graded school system.

5. Which of the following titles would best express the main topic of the passage?
   (a) The Father of American Public Education
   (b) Philosophy of Education
   (c) The Massachusetts State Board of Education
   (d) Politics of Educational Institutions

6. Which of the following would encourage Horace Mann to work hard?
   (a) Lack of school attendance.
   (b) Lack of support from friends.
   (c) Inspiration from Mann's father.
   (d) Motivation provided by teachers.

Read the following passage: <u>(Question 7-13)</u>

The question has often been asked why the Wright brothers were able to succeed in achieving manned flight, an effort in which so may others had failed. Many explanations have been offered, but three reasons are most often cited. First, they were a team. Both men worked well together, read the same books, located and shared information, talked incessantly about the possibility of manned flight, and served as a consistent source of inspiration and encouragement to each other. Quite simply, two geniuses are better than one.

They were also both glider pilots. Unlike some other engineers who experimented with the theories of flight, Orville and Wilbur Wright experienced the practical side of their work by building and flying in kites and gliders. Each craft was slightly better than the last, incorporating in it the knowledge that they had gained from previous failures. They had realized from their experiments that the most serious problem in manned flight would be stabilizing and maneuvering the aircraft once it was airborne. While others concentrated their efforts on the problem of achieving lift for take-off, the Wright brothers focused on developing a three-axis control for their aircraft. By the time that the brothers started to build an airplane, they were already among the best glider pilots in the world, and they knew the problems of flying first hand.

In addition, the Wright brothers had designed more effective wings for the airplane than had been previously engineered. Using a wind tunnel, they tested more than two hundred different wing designs, recording the effects of slight variations in shape on the pressure of air on the wings. The data from these experiments allowed the Wright brothers to construct a superior wing for their craft.

In spite of all these advantages, however, the Wright brothers might not have succeeded had they not been born at precisely the opportune moment in history. Attempts to achieve manned flight in the early nineteenth century were doomed because the steam engines that powered the aircrafts were too heavy in proportion to the power that they produced. But by the end of the nineteenth century, when the brothers were experimenting with engineering options, a relatively light internal combustion engine had already been invented, and they were able to bring the ratio of weight to power within acceptable limits for flight.

7. In contrast to the Wright brothers, other engineers
   (a) experimented with flight theories.
   (b) experimented with different wing designs.
   (c) experimented with different steam engines.
   (d) experimented with many pilots.

8. What was the outcome of collecting the data from the wind tunnel experiments?
   (a) The Wright Brothers could construct a more effective wing for their craft.
   (b) The Wright Brothers became famous pilots.
   (c) The Wright Brothers learned nothing from their experiments.
   (d) The Wright Brothers leaned new knowledge but it was not related to their objectives.

9. Why was building and flying kites and gliders important?
   (a) It gave the Wright brothers opportunities to solve aircraft problems.
   (b) It helped the Wright brothers to solve problems with take-off.
   (c) It made the Wright brothers work as a team.
   (d) It provided the Wright brothers opportunities to become famous pilots.

10. How did the Wright Brothers get their flight experience?
   (a) By reading books about the flight experience of others.
   (b) By attending a school for training aviators.
   (c) By building and improving kites and flying gliders.
   (d) By doing research about flight.

11. How did the Wright brothers build the wings for their airplanes?
    (a) By copying the wings of gliders they had flown.
    (b) By experimenting with different wing designs in a wind tunnel.
    (c) By using wings that had been developed by other engineers.
    (d) By collecting data from scientific literature.

12. According to the Wright brothers, what was the most serious problem in constructing a manned aircraft?
    (a) Achieving take-off.
    (b) Constructing the wings.
    (c) Controlling the aircraft.
    (d) Controlling the engine.

13. What was the problem with the steam engines used in earlier aircraft?
    (a) They were too small to power a large plane.
    (b) They were too light to generate enough power.
    (c) They did not have internal combustion power.
    (d) They did not have enough power to lift their own weight.

Read the following passage: (Questions 14-19)

The *Acacia* is a genus of trees and shrubs of the Mimosa family. Although nearly five hundred species of *Acacia* have been identified, only about a dozen of the three hundred Australian varieties grow well in the southern United States, and of these, only three are flowering. The *Bailey Acacia* has fernlike silver leaves and small, fragrant flowers arranged in rounded clusters. The *Silver Wattle*, although very similar to the *Bailey Acacia*, grows twice as high. The *Sydney Golden Wattle*, is squat and bushy with broad, flat leaves. Named for its bright, yellow flowers, the *Golden Wattle* is the most showy and fragrant of the Acacias. Another variety, the *Black Acacia* or *Blackwood*, has dark green leaves and unobtrusive blossoms. Besides being a popular tree for ornamental purposes, the *Black Acacia* is valuable for its dark wood, which is used in making cabinets and furniture, including highly prized pianos.

The *Acacia*'s unusual custom of blossoming in February has been commonly attributed to its Australian origins. In the Southern Hemisphere, of course, the seasons are reversed, and February, which is wintertime in the United States, is summertime in Australia. Actually, however, the pale, yellow blossoms appear in August in Australia. Whether growing in the Northern or Southern Hemisphere, the Acacia will bloom in winter.

14. Which of the following topics does the passage concern?
    (a) The Acacia Trees
    (b) Characteristics and varieties of the Acacia
    (c) Australian varieties of the Acacia
    (d) The use of Acacia wood for producing perfume

15. Why do we use the Black Acacia in making pianos?
(a) Because it is a dark wood.
(b) Because it is a hard wood.
(c) Because it is a strong wood.
(d) Because it is a smooth wood.

16. The Golden Wattle differs from Blackwood because
(a) Golden Wattle has flat leaves, but Blackwood has dark green leaves.
(b) Golden Wattle has flat leaves, but Blackwood has black leaves.
(c) Blackwood has dark green leaves, but Golden wattle has yellow leaves.
(d) Blackwood has black leaves, but Golden Wattle has flat leaves.

17. Which of the following statements best describes the characteristics of Acacia?
(a) Acacia will bloom in Winter in the Southern Hemisphere.
(b) Acacia will bloom in Winter in the Northern Hemisphere.
(c) Acacia will bloom in Summer in the Southern Hemisphere.
(d) Acacia will bloom in Winter in both the Southern and the Northern Hemisphere.

18. What would happen if we cultivated Acacia in the Northern United States?
(a) They would grow well.
(b) They would have more flowers.
(c) They would grow well but need more water.
(d) They would not grow well.

19. How are the Bailey Acacia and Silver Wattle similar?
(a) They are squat and bushy with broad, flat leaves.
(b) They grow to the same height.
(c) They have small, fernlike silver leaves.
(d) They are used in making furniture.

Read the following passage: <u>(Question 20-26)</u>

American pikas live on high mountain slopes, and, until recently, little was known about their social structures. To find out more, the author and colleagues began a research program of study in the subalpine zone of the Rocky Mountains of Colorado, an altitude of 3,200 feet above sea level. They ended up with more than 750,000 lines of data and a fairly good idea of a pika's activities during each season of the year. In winter, Pikas don't hibernate, but they apparently sit tight, eating from the haypiles that they have so industriously collected during the preceding summer. They also make tunnels through the deep snow leading to plants on nearby meadows. After they have survived the winter, pikas are very busy in the spring.

Then, in the spring, pikas mate early, giving birth just as the snow is melting. Pregnant females do not need to eat fresh vegetation, and they even put on fat while waiting for the snow to clear. But if mothers are to wean successfully their litters (between one and four), they must eat the new vegetation that adorns alpine meadows as soon as the snow melts. Females mate twice each season, but normally only the first litter survives. The second litter appears to be a sort of insurance policy, designed to cover the parents if the first litter fails for any reason. Failure of the first brood can occur in years when the snow melts late or when a nest is raided by a predator. Once the babies are born, pikas must begin collecting food during the summer months.

During the summer, Pikas prepare for the coming winter. Gathering plants to make hay is necessary for winter survival, but risky, because pikas are particularly vulnerable to predators when they are out gathering food. When they detect predators, they usually warn their neighbors by giving a repetitive short call, which is then relayed from pika to pika across the slope. Pikas are highly territorial: each adult maintains an individual territory, proclaiming its property rights by calling, as well as by leaving scent marks, which it creates by rubbing its cheek glands on rocks. Pikas are often hostile, chasing off intruders—including their own young sometimes. Weasels may take advantage of territorial fights to move in and kill distracted pikas. The next season is the end of their food collecting.

Finally, in the autumn, Pikas put the finishing touches to their haypiles. Adult males begin creating their haypiles first, since they have no child-rearing responsibilities. Adult females begin as soon as they wean their young. Though the babies grow quickly during the summer, they must reach adult size and lay claim to a territory to have any chance of making it through the winter. They start their haypiles last and must scramble to complete them before the first heavy snows blanket the rocks and the annual cycle starts once again.

20. The collection of food by Pikas occurs
    (a) just as the snow is melting.
    (b) during the late winter months.
    (c) after the babies are born.
    (d) with the new vegetation on the meadows.

21. Fresh vegetation is mandatory for
    (a) pregnant females in the spring.
    (b) building nutritious haypiles.
    (c) females to put on protective fat.
    (d) females to wean their young successfully.

22. Which of the following topics does the passage concern?
    (a) The Pikas' rearing of their young.
    (b) The Picas' food collecting.
    (c) The Picas' feeding.
    (d) The Picas' annual activities.

23. What would happen if the Pikas have young when the snow melts late?
    (a) The litter would be strong.
    (b) The litter would not survive.
    (c) The litter would need more care.
    (d) The litter would be lost.

24. When do the Pikas' mothers eat the new vegetation that grows around the mountain?
    (a) After weaning their young.
    (b) After giving birth to their young.
    (c) Before the coming winter.
    (d) During the rearing of their young.

25. Haypiles for each member of a new litter
    (a) are begun as soon as the young are weaned.
    (b) must be completed before the first heavy snow.
    (c) are prepared by the adult male.
    (d) are not necessary until the next mating season.

26. Scent marks are created by
    (a) Pikas when they rub their cheek glands on rocks.
    (b) distracted Pikas who are building haypiles.
    (c) females who have lost their young.
    (d) relaying warning calls from Pika to Pika.

Read the following passage: <u>(Question 27-33)</u>

British corals belong to a group of animals called Cnidaria, with a silent 'c', which includes sea anemones and jelly fish. It's hard to imagine how such apparently different creatures can be so closely related, but at the most basic level, all consist of a mouth surrounded by tentacles. British corals can be split into three groups: hard corals, soft corals, and sea fans. Each of these three groups of Cnidaria are named for their type of body.

The first group is hard corals. Hard corals have a stony skeleton, which is made almost completely of calcium carbonate. This tough, slow-growing structure provides the soft, vulnerable polyp of the animal with a safe home into which it can withdraw its tentacles in times of danger. Some British corals are solitary. They are known as cup coral, and they live as separate individuals rather than fused together to form a colony, though there might be many others of the same species nearby. Of the colonial hard corals, the smallest is the carpet coral *Hoplangia durotrix*. It grows in clusters up to 5cm across, hidden at the back of dark caves and crevices from the shallows down to about 25 meters. The largest of all the British corals, hard or otherwise, doesn't even have a common name. *Lophelia pertusa* lives only in deep water from 50 to 3,000 meters and is called the "rainforest of the sea" because it is home for many marine creatures.

The second group of British corals is soft corals. Soft corals belong to a subclass called Octocorals. Because each of their polyps has eight tentacles. They have no hard skeleton but instead form a gelatinous mass supported by tiny calcareous threads. The tentacles grow from this 'body', and these collect particles of food from the water column to feed the whole colony. The largest of the soft corals, *Alcyonium digitatum*, has the common name of "deadman's fingers," probably because this is what they resemble when the polyps are completely retracted. The smallest of the soft corals, Parerythropodium coralloides, forms small clusters of polyps up to only 4cm high joined by a thread of tissue at the base.

Sea fans are the third group of corals. Sea Fans, like soft corals, the polyps of sea fans, have eight tentacles. They grow in a branching form like miniature trees, each of the arms bearing the food-catching polyps. Sea fans are formed of a horny substance called gorgonim,which also gives them their more scientific title of gorgonians. There are two species growing in British waters. Around the west coasts of Scotland and Ireland, there is the northern sea fan *Swiftia pallida*, which forms slender colonies up to 20cm tall with few branches. The southwest coast of England is home to the larger pink sea fan *Eunicella verrucosa*, which can grow up to 40cm tall.

27. How are sea fan corals and soft corals are similar?
    (a) They are homes for many marine creatures.
    (b) They are joined by a thread of tissue at the base.
    (c) They have eight tentacles.
    (d) They have stony skeletons.

28. Polyps and tentacles, together, bear the main responsibility of
    (a) attacking predators.
    (b) forming colonies.
    (c) catching food.
    (d) protecting the colony.

29. Which of the following titles would best express the main topic of the passage?
    (a) The Characteristics of British Corals
    (b) The Type of Corals
    (c) The Characteristics of Solitary Corals
    (d) The Characteristics of Colony Corals

30. The coral which lives in the deepest areas of the North Sea is
    (a) "Deadman Fingers."
    (b) Sea Fan.
    (c) Cup coral.
    (d) a coral with no common name.

31. The substance called gorgonim is necessary in
    (a) the formation of the corals' sea fans.
    (b) forming slender colonies of coral.
    (c) fusing separate corals together.
    (d) attracting food to the coral.

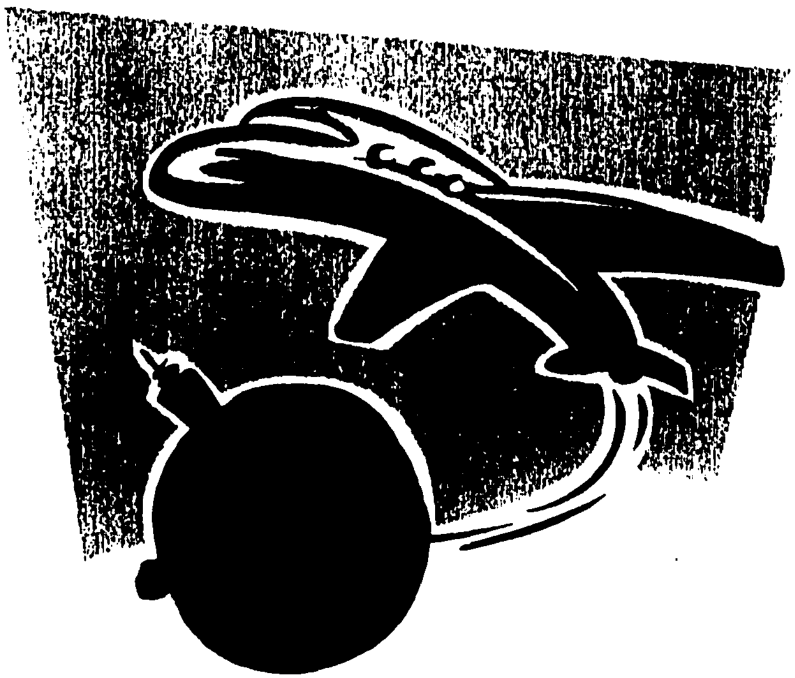
32. What do hard, soft, and sea fans corals have in common?
    (a) They are all located just off the North Sea.
    (b) Their body types are similar.
    (c) Each type of coral species includes sea anemones.
    (d) Each coral's mouth is surrounded by tentacles.

33. What makes cup corals different from carpet coral and the "rain forest of the sea"?
    (a) Cup corals are solitary.
    (b) Cup corals are a colony.
    (c) Cup corals grow in deep water.
    (d) Cup corals have a gelatinous mass.

Appendix F

The Students' Handout

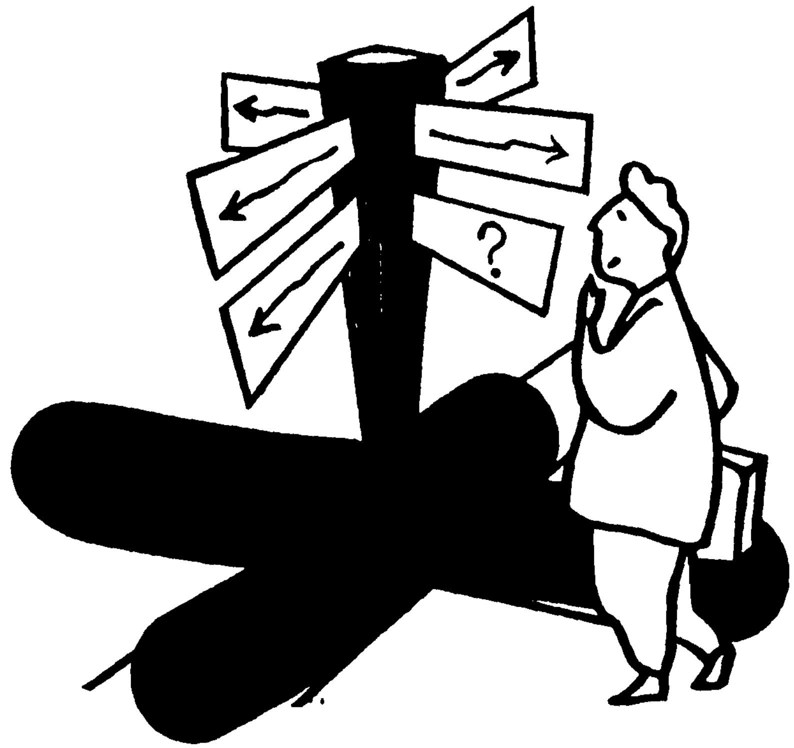
Concept Mapping
(The students' handout)



- **What is a concept map?**
- **Concept mapping and meaningfnl learning**
- **How is a concept map constructed?**
- **Examples of concept maps**

What is a concept map?

A concept map is a graphic arrangement of the key concepts in a body of subject matter with connecting lines labelled show valid and meaningful relationships between the chosen concepts. Simply defined, a concept map is a visual representation of how a student understands concepts and their relationships. Concept mapping provides a vehicle for integrating new information with information previously learned.



Concept Mapping and Meaningful Learning

Concept mapping is a tool for representing the interrelationships between concepts in an integrated, hierarchical manner. Concept maps depict the structure of knowledge in propositional statements that describe the relationships among the concepts in a map. Connected by labeled lines, the concepts depicted in concept maps have superordinate-subordinate relationships as well as interrelationships. Based upon Assimilation Theory, concept maps facilitate meaningful learning by making conceptual relationships explicit, and by serving as advance organizers to subsequent learning. Like knowledge itself, concept maps are context dependent. Different maps containing the same concepts may convey very different meanings depending upon the relative emphasis and arrangement of individual concepts. This feature makes concept mapping particularly helpful for illustrating the ways in which context influences both what we know and how we use what we know. It allows knowledge to be portrayed as dynamic and subject to change, and illustrates the integrated nature of understanding.

How is a concept map constructed?

A Concept map is the identification of concepts...and the organization of those concepts into a hierarchical arrangement from the most general, most inclusive to the least general, most specific concept. The following five steps can be used by students to construct a concept map. It is important to note, however, that these steps represent a recursive not a linear process.

1. Select major concepts to be included in the map.

2. Rank or organize the list of concepts from the most inclusive (superordinate) to the most concrete and specific. In general, there will be fewer abstract concepts than concrete ones.

3. Cluster the concepts according to two criteria: concepts that function at a similar level of abstraction (horizontally related) and concepts that interrelate closely (hierarchically related).

4. Arrange the concepts in a configuration to depict relationships among the concepts. This can be the most intense stage requiring rearranging, rethinking, reclustering, adding prior knowledge, and searching for input.
5. Link related concepts with lines and label each line with a logical connective.

Examples of Concept Maps

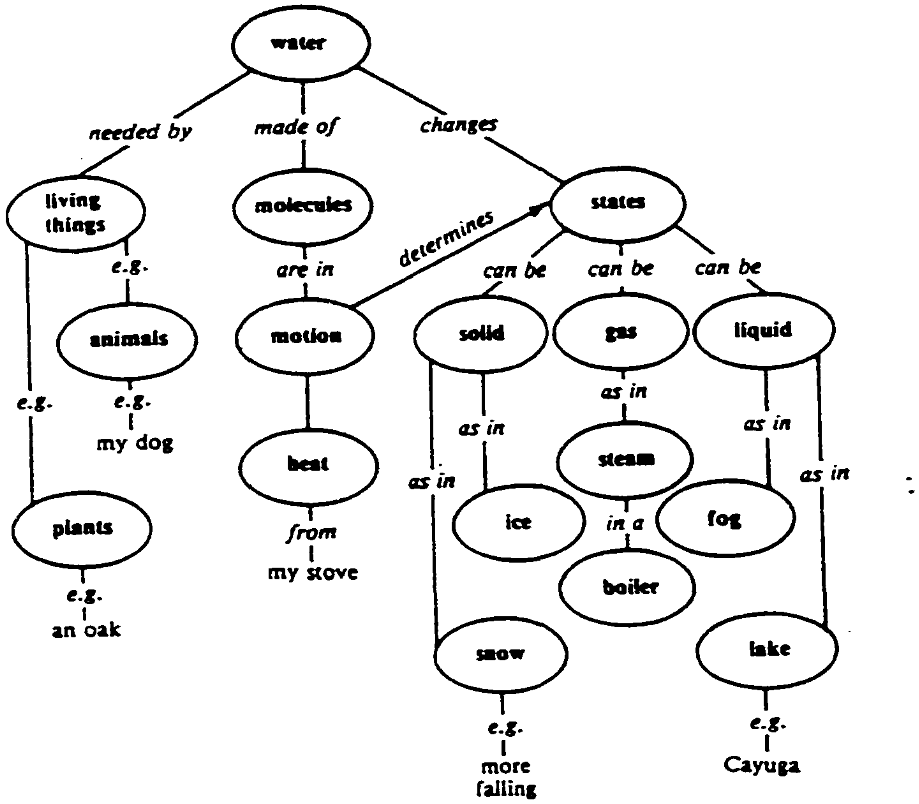


Figure 1. A concept map for water showing some related concepts and propositions.

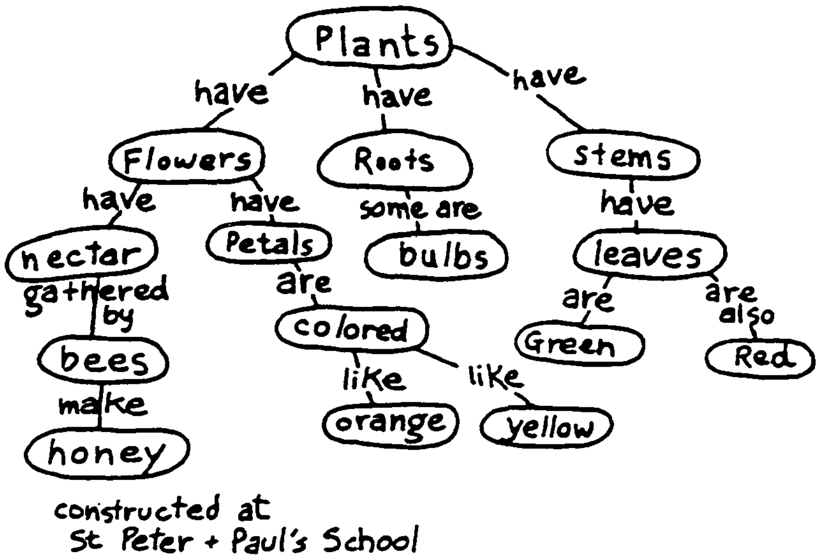


Figure 2. A concept map constructed by a first grade student.

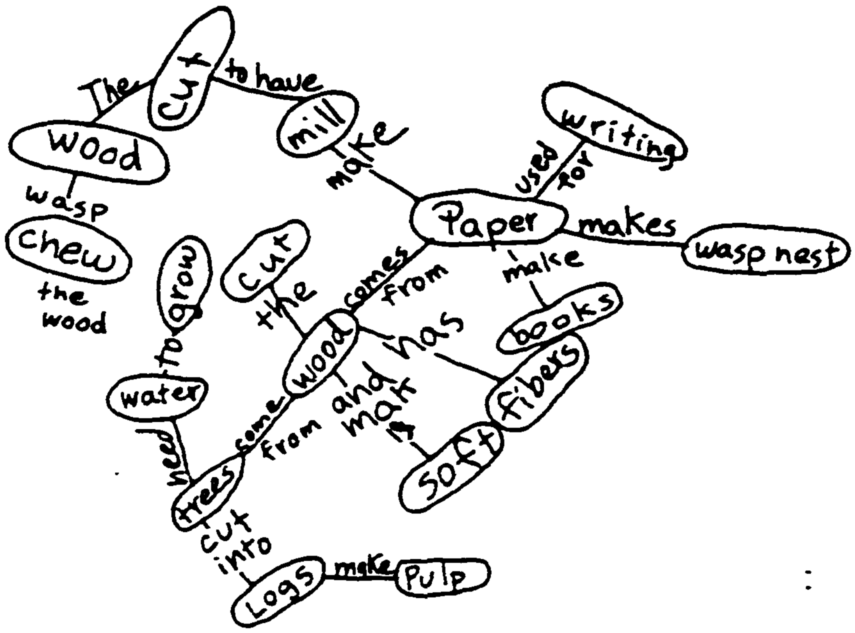


Figure 3. A concept map constructed by a fourth grade student, following a field trip to a paper mill, showing a good integration of concept meanings (see also Figure 4 showing poor integration of meanings).

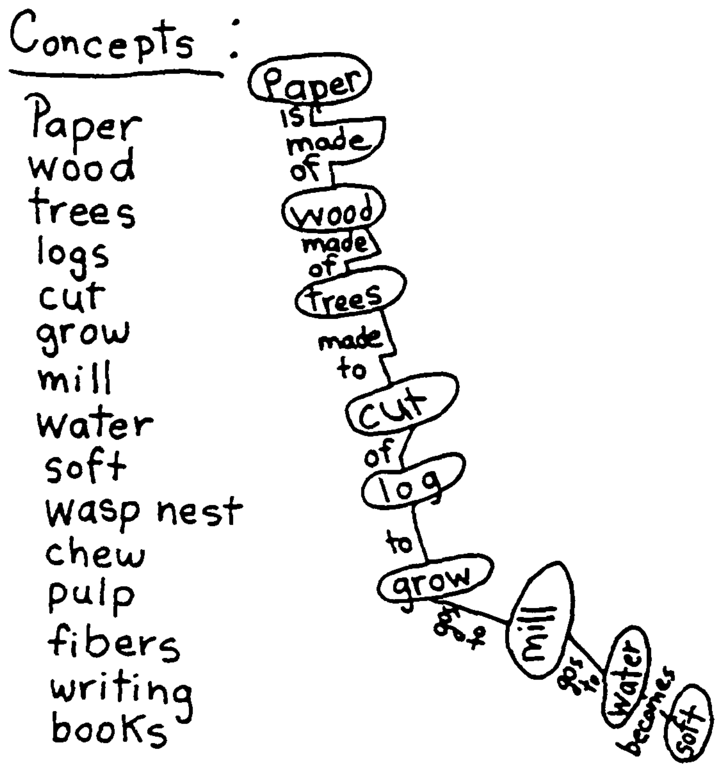


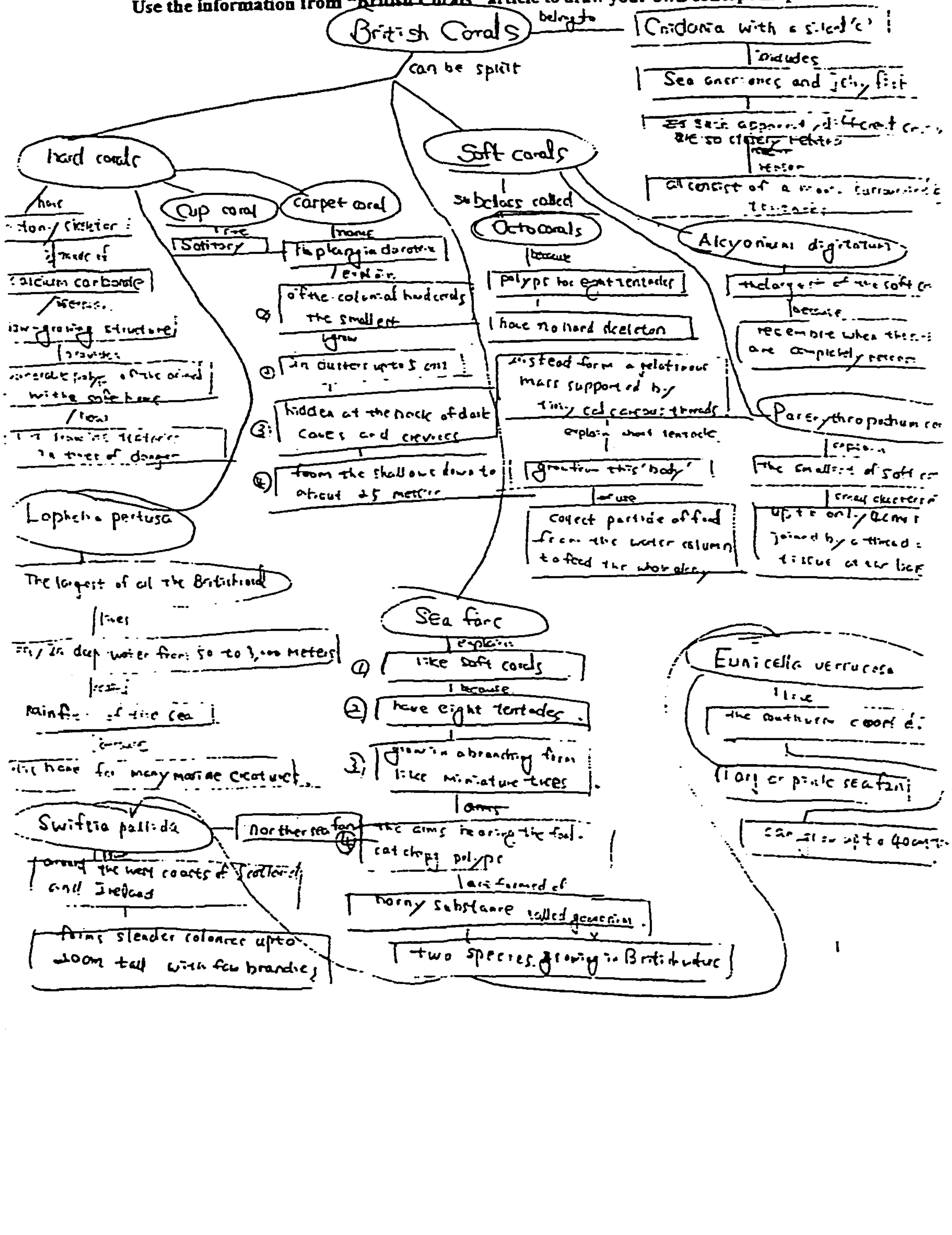
Figure 4. A concept map made by a fourth grade student showing a linear string of words without clear subordinate conceptual relationships. Such strings should not count as levels of hierarchies.

Appendix G

Example of the Student Concept Map

Student Name =

Use the information from "British Corals" article to draw your own concept map



Appendix H

IRB Permission Letter

The University of Oklahoma

OFFICE OF RESEARCH ADMINISTRATION

December 10, 1999

Ms. Pasana Chularut
1415 George Avenue #106
Norman OK 73072

Dear Ms. Chularut:

Your research application, "The Influence of Concept Mapping on Achievement, Self-Regulation, Self-Efficacy and Strategy Use in College Students," has been reviewed according to the policies of the Institutional Review Board chaired by Dr. E. Laurette Taylor and found to be exempt from the requirements for full board review. Your project is approved under the regulations of the University of Oklahoma - Norman Campus Policies and Procedures for the Protection of Human Subjects in Research Activities.

Should you wish to deviate from the described protocol, you must notify me and obtain prior approval from the Board for the changes. If the research is to extend beyond 12 months, you must contact this office, in writing, noting any changes or revisions in the protocol and/or informed consent forms, and request an extension of this ruling.

If you have any questions, please contact me.

Sincerely yours,

Susan Wyatt Sedwick

Susan Wyatt Sedwick, Ph.D.
Administrative Officer
Institutional Review Board

SWS:pw
FY00-115

cc: Dr. E. Laurette Taylor, Chair, Institutional Review Board
Dr. Teresa K. DeBacker, Educational Psychology

The University of Oklahoma

OFFICE OF RESEARCH ADMINISTRATION

October 19, 2000

Ms. Pasana Chularut
1415 George Avenue #106
Norman OK 73072

SUBJECT: "The Influence of Concept Mapping on Achievement, Self-Regulation, Self-Efficacy and Strategy Use in College Students"

Dear Ms. Chularut:

The Institutional Review Board has reviewed and approved your requested revisions to the subject protocol which we received on October 18, 2000.

Please note that this approval is for the protocol and informed consent form reviewed and approved by the Board on December 10, 1999. If you wish to make any changes, you will need to submit a request for change to this office for review.

If you have any questions, please contact me at 325-4757.

Sincerely yours,

Susan Wyatt Sedwick

Susan Wyatt Sedwick, Ph.D.
Administrative Officer
Institutional Review Board-Norman Campus

SWS:pw
FY00-115

cc: Dr. E. Laurette Taylor, Chair, IRB
Dr. Teresa K. DeBacker, Educational Psychology