

A COMPARISON OF FOUR INSTRUCTIONAL METHODS
OF DEVELOPING SIXTH-GRADE
SCIENCE VOCABULARY

A THESIS
SUBMITTED TO
The Faculty of the Graduate School
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In Partial Fulfillment
of the Requirements for the Degree
Master of Education

by
Colleen Elizabeth Lyne

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ABSTRACT

The purpose of the study was to investigate the differential effects of four instructional methods of developing sixth-grade science vocabulary. The four methods were identified as the cloze method (CL), semantic mapping (SM), category matching (CM), and story discussion (SD). The aim of each instructional method was to assist students in developing vocabulary related to specified science concepts.

The subjects in this study were 60 sixth-grade students. Four equivalent groups were formed by matching procedures based on the listening vocabulary subtest of the Durrell Listening-Reading Series, Intermediate Level, Form DE. Then each intact group was randomly assigned to one of the four treatments. Each treatment group received eight lessons of thirty minutes each. The target vocabulary selected for instruction was nouns which represented superordinate categories and subordinate terms for four science concepts taught at the grade six level. The target vocabulary was presented within the context of science passages written in a classification pattern. Timed word association tests were administered as pre- and post-tests.

Analyses of variance using the factors treatment, passage, and time, indicated significant interactions among the three factors. Multiple t-tests with the Tukey and Scheffé criterion of significance were used to probe the significant interactions.

Qualitative analyses were performed to investigate the differences within treatment groups and the sensitivity of the measures

used. The results revealed that the treatment groups were basically equal prior to instruction and further both measures (Durrell and target word association test) assessed similar effects and, hence, were appropriate measures for the purpose of this study. However, the total word association measure tended to include experiential vocabulary which obscured the difference in target words gained as a result of the experimental treatments and, hence, it was not considered an appropriate measure for the purpose of this study.

The results of the study led the investigator to conclude that (1) the treatment effectiveness was passage dependent; (2) the three treatments which involved direct instruction (CL, SM, CM) were more effective than the treatment which involved incidental instruction (SD); (3) the frequency variable as employed in this study was not effective and that interest and experience may override the frequency variables; and (4) the qualitative analyses showed that the Durrell Listening Vocabulary test and the target word association test assessed similar effects and, hence, were appropriate measures for the purpose of this study but the total word association measure was insensitive to the dependent variable.

Chapter 1

PURPOSE AND SIGNIFICANCE OF THE STUDY

Purpose

The purpose of this study was to investigate the differential effects of four instructional methods of developing sixth-grade science vocabulary. The four methods were identified as the cloze method, semantic mapping, category matching, and story discussion. The aim of each instructional method was to assist students in developing vocabulary related to specified science concepts.

Past research has demonstrated that strategies for vocabulary development which focus on systematic instruction are superior to those which attempt to develop vocabulary by means of incidental instruction (Petty, Herold, and Stoll, 1968). More importantly, the relative effectiveness of different instructional strategies is largely ignored in research (Pany & Jenkins, 1977). Also Spache and Spache (1977) suggest that the role of contextual effects becomes more significant to the development of a meaning vocabulary as students enter intermediate grades and are faced with content area material.

This study was undertaken as a result of the limited number of studies available which test the cloze, semantic mapping, and category match teaching strategies for the purpose of expanding or refining a concept (Jongsma, 1980; Pany and Jenkins, 1981; Anderson and Freebody, 1981). More specifically, there appears to be a general lack of practical information available about the technique of semantic mapping (Nease

1979). A further concern is the factor of the effect of word frequency within passages (Wittrock et. al., 1975; Marks et. al., 1974; Coleman, 1971). Although experimental studies often control for the frequency variable, pragmatic ones seldom do. Therefore, the purpose of this study was directed towards establishing controls for: the average level of word frequency, the structure and readability of the passages, specific concepts within a content area, and the degree of exposure to context. Then, a comparison of the three methods of vocabulary development was undertaken, and a control (benchmark) method was established in order to determine which was the most effective of the instructional methods.

The problem in a comparative study of this nature is twofold; the importance of determining which instructional strategies are effective and selecting which measures are most efficient for measuring this effectiveness. In comparative studies, Jongsma (1980) suggests that, in order to assess effectiveness, the dependent or criterion measures must be closely aligned with the instructional methods used.

The first problem is addressed by Anderson and Freebody (1981: 77). They summarized the literature on what is known about the role of vocabulary knowledge in reading comprehension. Their rationale for the importance of a review is that "an assessment of the number of meanings a reader knows enables a remarkably accurate prediction of this individual's ability to comprehend discourse". Although the reason for this correlation is not understood completely, its importance is recognized. If educators are to provide improved instruction they must determine the answer to the question: "What is the most efficient way of estimating vocabulary size from an individual's performance on a sample of words?" (Anderson and Freebody, 1981:77).

Thus, the second problem is measuring the effectiveness of vocabulary development is finding an adequately sensitive measure.

Deese (1970:109) states:

The sum total of all things a given person thinks of or that a whole group of people think of is the associative meaning of the concept behind the stimulus word in question.

The use of the word association test as a tool for research dates back to 1901 when Thumb and Marke found several general trends in response patterns. Word association test norms were established as early as 1910 (Kent and Rosanoff). Numerous studies have been conducted utilizing these norms (Jenkins and Russell, 1952; Russell and Jenkins, 1954; Russell and Meseck, 1959; Rosenzweig, 1964; Palermo and Jenkins, 1965). Further studies examined word association in an attempt to explain acquisition and development of linguistic knowledge (Ervin, 1963; McNeill, 1966; Froese, 1977; Taylor, 1977). These researchers emphasized the role of context in word association tasks.

A continued word association test is a variant of the simple word association test. The subject produces as many words as possible in a given time in response to a given stimulus word. Noble (1952) established, through the use of the continued word association test, the "meaningfulness (m)" of nouns and nonsense disyllables. He then had subjects rate the number of times they had come in contact with a particular word. He found a correlation of 0.92 (Noble, 1953). On the basis of these findings Taylor (1977:71) suggests that:

Since meaningfulness is an index of the variety (more correctly, frequency) of experiences represented in the concept, the more varied or frequent experiences one has with a concept, the more meaningful the concept becomes.

Kimble and Garnezy (1968) also found a functional relationship between the ease of learning and the meaningfulness of words.

Therefore, the continued word association test appears to be a measure which would be sensitive to the treatments undertaken. For example, Byrne (1971:392) found that "cloze performance is related to the divergent thinking ability of associational fluency". Also, the theories upon which semantic mapping is based, are primarily word association theories (Collins and Quillian, 1969; Lindsay and Norman, 1972). And, as well, category match is a word association task which was formulated as a result of the work done on categorization by Bruner, Goodnow and Austin (1956) and described by Gerhard (1975), Henry (1974) and Bower et. al. (1969).

Significance of the Study

The present study was designed to investigate instructional strategies that would build up students' facility in learning vocabulary related to concepts which appear in their science textbooks. The following concerns prompted the writer to undertake this study.

Although it is accepted that vocabulary knowledge is a major factor in linguistic ability, it is not clear why this is so. Anderson and Freebody (1981) attempt to explain why, by summarizing three positions: the instrumentalist position, the verbal aptitude position, and the knowledge position. They suggest that there are neither the theoretical tools, or the data to justify choosing one position as being more tenable than another at the present time. They further conclude that knowing which of these three positions about vocabulary knowledge is most nearly correct, is important because the positions have radically different implications for the reading curriculum.

One textbook for example, Johnson and Pearson (1978), basically supports the knowledge position. It discusses vocabulary development in terms of conceptual distinctions and relations which are called semantic maps. Semantic maps are encouraged as a method of developing vocabulary for the purpose of expanding concepts. Although these semantic maps involve sets of words, the activities described are based on groups of isolated words rather than words within the context of continuous text. Thomas and Robinson (1982) and Stoodt (1981) also make reference to Johnson and Pearson's (1978) semantic maps. However, other current textbooks (Spache and Spache, 1977; Durkin, 1978; Ranson, 1978) do not mention semantic maps and, to the writer's knowledge, no research studies could be located which provide evidence to support the use of semantic maps as an effective vocabulary method.

Within the Johnson and Pearson (1978) text, category match is described as an activity to help children develop a meaning vocabulary. More explicitly, they suggest it is an activity whereby many words can be introduced which are new to a child's vocabulary. This activity is also based on groups of isolated words as was the semantic mapping task.

The cloze instructional technique is discussed in the chapter entitled "Contextual Analysis" by Johnson and Pearson (1978). Here, the authors recommend selecting passages from content area material, as well as other sources for the purpose of constructing cloze activities. Through the use of the cloze procedure, they suggest that children will develop "the habit of examining surrounding context to make sensible guesses about the meanings of unfamiliar words" (Johnson and Pearson, 1978:118). However, research studies are not cited in this text to support the use of cloze as a vocabulary teaching device even though

numerous studies are available in the literature (Nease, 1979; Jongsma, 1980).

Although efforts are presently being made to integrate theory with practice, in current textbooks such as Johnson and Pearson's (1978), it appears that many gaps still exist. In a recent review, Trabasso (in Santa and Hayes, 1981) suggests that vocabulary knowledge research is omitted, or non-existent, and that if research is to have relevance to educational practical everyday life situations, it must use reading situations that have ecological validity.

In view of the above concerns, this study sought to investigate the instructional strategies of semantic mapping, cloze, and category match, within the context of the theoretical and practical research now available. It appears that more research studies are needed to help clarify present issues. This study differs from other studies in that it examines the practical application of semantic mapping as an instructional method for developing vocabulary. Also, in an effort to establish ecological validity, this study has placed vocabulary development into the context of the reality of reading. Therefore, the activities as outlined by Johnson and Pearson (1978), were modified so that the vocabulary studied was presented within the context of science passages written in a classification pattern. Further, word frequency within passages was considered as well as the degree of exposure to context, in an effort to more closely analyze the learning tasks which face the developing comprehender (Johnson in Santa and Hayes, 1981).

Theoretical Framework

One instructional method in vocabulary development may be more effective for material written in a specific organizational pattern than another and, therefore, improve reading comprehension. The assumptions underlying instruction in the semantic mapping, cloze method, and category matching task, are based on psycholinguistic theories.

Psycholinguists tend to view comprehension and memory as being a constructive process. The constructive process is based on the interaction of the information presented, the context of that information and the existing knowledge schemata of the learner (Pepper, 1942; Piaget, 1970; Bransford and Frank, 1971).

A current psycholinguistic model of reading posits a three component basis for reading. Three kinds of information are available to the reader: the grapho-phonetic, the syntactic, and the semantic-associational; all of which operate in mutually dependent and reciprocal manners (Goodman, 1967; Smith, 1975). However, research by Pearson (1975:189), provides evidence that "the way in which verbal data are processed, must begin with a semantic representation of the total relation involved". Thus, research in vocabulary development can be enhanced by viewing it from a semantic perspective.

While the stated purpose of this study was to compare four instructional methods of developing science vocabulary, an underlying purpose was to interpret the results in terms of theories of cognitive processes. More specifically, to relate the results to research, in theories of semantic memory.

Presently, research sets forth three distinctions among memory models which suggest two fundamentally different approaches to comprehension. The three models currently reviewed in the literature are the feature comparison model (Smith, Shoben and Rips, 1974), the marker search model (Glass and Holyoak, 1975), and the hybrid model (Collins and Loftus, 1975). A concern of the educator who is planning instructional strategies to develop vocabulary is some knowledge of the basic processes in terms of the three models. According to Shoben (in Spiro, 1980) the question of access and the question of context should be investigated. In this case, "access" refers to the time required to recall words or related concepts and "context" refers to the graphic material which surrounds a particular word and, therefore, designates or influences its meaning. And, further, that inherent in the question of access is "whether processing of one term will facilitate the subsequent processing of a semantically related term" (Shoben, 1980:323) and what part does context play within this process. Here "context" is viewed slightly different. For example, words such as bread and butter are closely associated and should require less time to recall than words such as nurse and butter which are not closely related (Meyer, Schvaneveldt and Ruddy, 1975).

In summary, the purpose and significance of this study was directed towards investigating instructional strategies which would enable students to learn vocabulary related to specified science concepts. An inherent problem in comparative studies appears to be the sensitivity of the criterion measure. Thus, the continued word association test was selected for determining the effectiveness of the instructional methods, as it seemed most closely aligned with the treatments in question.

Another inherent problem in comparative studies is the lack of effort in integrating theory with practice. Theoretically, research suggests semantic mapping is closely aligned with semantic memory models. However, the practical research on semantic mapping seems limited. Reported research on semantic memory models and their implications for instruction leave many questions unanswered. In fact, many current methodologies for the purpose of developing vocabulary are not placed within a theoretical framework. Neither does there appear to be substantial research to support their practical application. Thus, a brief summary of methodologies and justification for their use follows.

Methodologies

The four methodologies selected for developing sixth-grade science vocabulary were: the cloze method, semantic mapping, category matching, and story discussion. These methodologies are discussed in sequence with reference to their theoretical perspective.

Cloze Method

A psycholinguistic model of reading places great emphasis on the role of context in the processing of text. Psycholinguists claim that if students are taught to be sensitive to the semantic and syntactic clues in the text, they will become more proficient at retrieving from storage, words which are right the first time. It was this rationale which prompted the use of the cloze method as a vocabulary instructional method.

Semantic Mapping

Vocabulary development, by means of semantic mapping, is thought to be closely aligned with a hierarchical memory structure and, theoretically, is termed "semantic networks" (Collins and Quillian, 1969; Rumelhart, Lindsay and Norman, 1972). The current hybrid model of Collins and Loftus (1975) is partially based on the initial work of Collins and Quillian (1969). germane to this study was the question of whether students would have access to more new science vocabulary as a result of applying the semantic mapping technique to a passage in which the context is organized in a classification pattern.

Category Matching

According to Bruner, Goodnow, and Austin (1956), Piaget (1952), and Vygotsky (1962) categorization is involved in concept formation. Category match is basically categorization as described by Gerhard (1975) and Henry (1974) and it does not depend on a hierarchical memory structure, but is representative of an interpretive model of memory (Anderson and Bower, 1973). This method of vocabulary development is not sensitive to the role of context in processing text.

Story Discussion

This instructional method of developing vocabulary was viewed as conventional. Therefore, instruction was incidental rather than directed.

Current methodologies in developing vocabulary such as dictionary practice, matching synonyms and antonyms, study of word parts, and use of context (Petty, Herold, and Stoll, 1968) have no clearly established theoretical basis. Also, "research in the area of vocabulary

development has not dealt with the theoretical basis for the methods used" (Gipe, 1977:5). Further, in a recent review of the book Teaching Reading Vocabulary, by Johnson and Pearson (1978), Nease (1979:77) states that this book "shares a short coming common to most works on teaching methods . . . activities are not placed within the context of research" and that "such a resource should be based on a thorough review of current literature". The intent of this study was to examine the instructional methods of cloze, semantic mapping, and category matching, in terms of both theory and the existing research in vocabulary development.

While there are many descriptive studies on vocabulary in the literature (Dale, Razik and Petty, 1973) there are relatively few studies which directly document the relative effectiveness of specific vocabulary instructional methods (Pany and Jenkins, 1977). Because of the lack of evidence to support current practices in developing vocabulary, many researchable questions can be formulated within the theoretical framework presented. However, for the purpose of this study, three general questions were examined. Each general question resulted in a number of specific hypothesis; these are presented in more detail in Chapter 3.

The general questions were:

1. Do different instructional methods result in different word association scores when assessed by number of target words (i.e. words which were the focus of instruction) and by the number of target words (i.e. other words in addition to target words)?
2. Do instructional methods with two science passages containing words which, on the average, are more familiar to grade six

students (high frequency passages) result in greater gains than methods with two science passages containing words which, on the average, are less familiar to grade six students (low frequency passages) when word association scores are assessed by target words and association total?

3. What are some qualitative differences among students' performance on word association scores when examined for difference in treatment groups as measured by: the Durrell, total pre-test target words, total task scores and total post-test association scores, and the relationship of Durrell scores and total target word post-test scores?

Definition of Terms

The following operational terms have been used throughout this study and have been defined as follows:

1. Semantic Map: A semantic map is a graphic representation used to illustrate concepts and relationships between concepts such as classes, properties, and examples (Pearson and Johnson, 1978).
2. Semantic Mapping: Semantic mapping is the development of a semantic map. The student's task is to correctly supply the words to complete the graphic representation.
3. Cloze Method : A modified cloze method is a technique in which specified words in a passage are deleted. Letter clues are sometimes given. The reader's task is to correctly supply the missing word.
4. Category Matching: Category matching is a classifying activity in which two or three (or more) categories are written at the top of the page and several words for each category are scrambled below them.

The student's task is to correctly place the scrambled words in the appropriate category. "Category Match" is used synonymously.

5. Concept: A concept is an idea or notion derived from assessing particular relationships and characteristics of things (Johnson and Pearson, 1978). For the purpose of this study, the terms passage and story are used interchangeably.

6. Context: Context refers to those sounds, words, phrases, pictorial and graphic matter which surrounds a particular word or passage and designate or influence its meaning.

7. Frequency: Frequency refers to an account of how often a particular word occurs in the language according to the norms in the Word Frequency Book (Carroll et. al., 1971).

8. Classification Pattern: Classification pattern refers to the nature and organization of written material. In a classification pattern, a topic is divided into two or more parts, followed by sub-topics that are grouped under each part. The divided topics and sub-topics are explained or described (Robinson, 1975).

9. Semantics: Semantics refers to the study of meanings, especially concepts and relations among concepts (Pearson and Johnson, 1978).

10. Syntax: Syntax refers to the orderly arrangements of words in sentences (Pearson and Johnson, 1978).

11. Target Words: "Target words" refer to the actual words introduced for study.

12. Total Words: "Total words" refers to a count of the target words and any other word elicited in response to a superordinate.

13. Timed Word Association Test: For the purpose of this study, a time limit of two minutes was established for the word association test.

Limitations of the Study

1. The investigation was limited to analyzing data for sixth-grade students in two schools in one rural school division and cannot be generalized beyond this setting.
2. The investigation was limited to four methods of teaching science vocabulary related to four specified concepts written in a classification pattern and cannot be generalized to other teaching methods, vocabulary or writing patterns.
3. Due to time constraints, the study consisted of only eight lessons per group over a four week period.
4. Measurement of the students' performance was limited to the accuracy and validity of the timed word association tests used as measuring devices.

Overview of the Study

This study compared four instructional methods of developing sixth-grade science vocabulary.

Chapter 1 has stated the purpose of the study, discussed the significance of the problem, described the theoretical foundations for the study, defined terms of importance to the study, and listed the limitations of the study.

Chapter 2 will review literature and research related to the study.

Chapter 3 will present a description of the sample, the design of the study and the research procedure and materials used in the study.

Chapter 4 will present an analysis of the data.

Chapter 5 will present a summary of the findings, conclusions drawn from the findings, implications for educational practice, and suggestions for further research.

Chapter 2

REVIEW OF RELATED LITERATURE

The purpose of this study was to investigate the differential effects of instructional methods for developing sixth-grade science vocabulary. The methods were identified as the cloze method, semantic mapping, and category matching. The aim of each instructional method was to assist students in developing vocabulary related to specified science concepts. In an effort to establish ecological validity, this study placed the target vocabulary within the context of continuous text so that it might more closely parallel the reading situation. The purpose of this chapter was to discuss vocabulary development within a framework which has theoretical and pedagogical relevance. Therefore, the first section of this chapter will review, from a theoretical and pedagogical perspective, literature which relates to the process of reading. Next, the chapter contains sections which are relevant to the purpose of the study and deal with the identified methods: cloze, semantic mapping, and category matching.

Process of Reading

Psycholinguistic Model

Current research in reading has focused on the interrelationships of language, memory structure, and the interaction of the learner. Varying degrees of emphasis are placed on these interrelationships depending upon the theoretical perspective of the researcher.

Currently, several psycholinguists (Goodman, 1967; Hochberg, 1970; Kolers, 1970; Smith, 1975) discuss in the literature, language based models of the reading process. Although these psycholinguists differ on some issues, certain explanations of the reading process appear to be in agreement. Akin to Bruner (1973) these psycholinguistic models are based on the "predict-test-confirm" procedure (Goodman, 1968).

Models of this type require the reader to be cognitively active. That is, the reader must utilize his prior knowledge to generate hypothesis about what is being read. Thus, an important aspect of cognitive activity is anticipating, expecting or predicting part of the information which he has not yet seen. This anticipatory behavior is not completely understood, but it is believed to enhance reading efficiency by capitalizing on the natural redundancy of written language.

One current psycholinguistic paradigm of reading is the Goodman Model. The Goodman Model (1970) places a high degree of emphasis on semantic and syntactic anticipation, with less emphasis on the graphics of print. According to this model, an efficient reader decodes directly from the graphic stimulus, and then encodes from the deep structure. This is made possible because the reader utilizes three kinds of information simultaneously. This process is described by Goodman (1970:266) as:

Certainly without graphic input there would be no reading. But the reader uses syntactic and semantic information as well. He predicts and anticipates on the basis of this information sampling from print just enough to confirm his guess of what's coming to cue more semantic and syntactic information. Redundancy and sequential constraints in languages which the reader reacts to makes this prediction possible.

Thus, semantic and syntactic anticipation involves narrowing the set of candidates for upcoming words, by using information from prior text. The underlying assumption upon which this model is based is "that oral and written modes of language are alternate modes of the same entity and are more or less abstract representation of each other" (Cambourne, 1976:611). It also implies that the oral reading process reflects the silent reading process.

The literature has extensively addressed this paradigm of the reading process. The conclusions, however, appear to be somewhat controversial. On the one hand, the "Goodman Model" is viewed as an analysis by synthesis model of reading and, consequently, it accounts for rapid reading with minimal visual input, for changes in reading rate with different types of text, and for misreadings being syntactically and semantically appropriate (McConkie and Rayner, 1976). On the other hand, the basic assumption underlying this language based model of reading and the research paradigm within which it was formulated are questioned.

Cambourne (1976), Mosenthal (1976) and others, question the assumptions of parallelism; between the oral and written modes of language and between oral and silent reading. Secondly, does the "naturalistic" research paradigm utilized by Goodman provide valid and reliable evidence to support the contentions he puts forth in relation to the application of general linguistic and cognitive competencies (Pearson, 1981)? It seems that empirical evidence to support the basic assumptions and the practical applications of the same are somewhat vague. In fact, there is no conclusive empirical evidence to support the assumption that comprehension of speech parallels

comprehension in reading either orally or silently (Posner et. al., 1972). Secondly, it seems "a number of causal implications have been drawn from descriptive statistics" and Goodman has "failed to support his most echoed implications, subjects would 'learn' better as a result of encountering new words in context" (Blanchard, 1979:71).

A third problem, which is probably the most crucial to the present study, is the implication that semantics is a function of syntax, or that a word's meaning appears to be contingent upon its ordered relation to other words (Mosenthal, 1976). This has important implications for how educators develop vocabulary. However, the postulate that semantics is a function of syntax is possibly a direct result of Goodman's reliance on the linguistic paradigm of transformational-generative grammar and, therefore, requires further discussion.

Influence of Transformational-Generative Grammar

A linguistic paradigm which was current prior to the inception of "Goodman's Model" was Chomsky's (1957) theory of syntax. Thus, this paradigm possibly provided the motivation for pursuing a performance model of reading comprehension which would match the listener's ability to comprehend speech. However, it was Chomsky's (1965) theory of syntax, expressed in a transformational-generative grammar which has had far-reaching implications for many reading theorists and reading practitioners.

Basic to Chomsky's (1965) nativistic theory of spoken language is:

. . . an innate capacity for processing linguistic data in the environment, sorting the data, establishing a structured set of rules, and then using the set of rules to generate an infinite number of creative sentences (Dahl, 1981:4).

Thus, through grammar, we may generate, specify, and predict all the possible linguistic relations between the sound system and the meaning system of language. Chomsky proposed a tripartite structure which included deep structure (abstract representations which reflect meaning or the semantic component), transformational rules (the syntactic component), and surface structure (the phonological or graphic component). Through syntax, we generate and describe all sentences within a language; through phonology, we describe the sound structures of the sentences generated by the syntax; and the semantic component refers to the meaning structure of the sentence. Thus, according to Chomsky (1965), the syntactic component plays the dominant role as both the phonological and semantic components are dependent on its function.

The literature reviewed in the psycholinguistic field has provided evidence that psycholinguistic reading models in general, and the Goodman (1968) and Smith (1975) models, specifically have been influenced by differing interpretations and applications of Chomsky's (1965) theory of transformational-generative grammar. For example, Goodman (1973:37) appears to agree that syntax is the principle determiner of meaning:

The structural organization of a sentence forms the basis for semantic relationships. Meaning as a language system, is dependent on syntax. It is the order of items and the use of inflection that indicate the meaning relationship of the items. The syntactic order is separate from and can precede the meaning but the meaning cannot exist without the order.

However, not all reading theoreticians hold this same view. A number of empirical investigations (Bransford and Franks, 1971; Sachs, 1967; Pearson, 1974-1975) have found the theory of transformational grammar inadequate for the purpose of explaining the reading comprehension

process. Consequently, psychologists and educators moved toward an alternative model of grammar which might more adequately explain the reading process.

Influence of Case Grammar and Generative Semantics

Case grammar (Fillmore, 1968) and a semantically based model of transformational grammar provided alternatives within which theoreticians viewed models of reading comprehension. Case grammar was especially appealing as it did not assume the sentence to be the basic linguistic unit as did the transformational-generative grammarians. The generative semanticists (Anderson, 1968; Chafe, 1967; Lakoff, 1968; McCawley, 1968) held differing views on the function of "selectional restrictions" within Chomsky's (1965) theory. However, a common view among them was their rejections of deep structure in the form defined by Chomsky (1965). They placed semantics in a more dominant role than syntax. A brief summary of both theories is presented.

In a case grammar analysis, the action becomes the focal point, around which all other concepts in an event revolve. An event may consist of one sentence or a number of sentences. Thus, understanding language means understanding the semantic relationships expressed by language. This relationship is described; by first identifying the basic "action", second, the "agent", who or what caused the action to occur, and thirdly, who or what is the "recipient" of the action. It appears that semantics and syntax are dependent upon one another in case grammar although the dominant role now appears to be semantics, as syntax is viewed as an aid to meaning (Lapp and Flood, 1978). As Fillmore (1968:24) states:

The case notions comprise a set of universal, presumably innate concepts which identify certain types of judgements human beings are capable of making about the events that are going on around them, judgements about such matters as who did it, who it happened to, and what got changed.

Although the scenario of an event is made up of the "action", "agent", and "object", the parts of an event might also include the instrumental relation, the conditional relation, and the reference relation.

In generative semantics, all the generative power of the grammar is located in the semantic component, the rules of which operate prior to the operation of the "now" purely interpretive rules of the syntactic component. Thus, semantics is generative (reflecting the creative or productive aspects of language), while phonology and syntax are interpretive (assigning a phonetic and syntactic interpretation to abstract structures generated by semantics) (Lyons, 1972). The literature on semantically based transformational grammar has suggested that this view holds greater promise for theoreticians than does the type of grammar discussed by Chomsky (1965).

Linguistic theories which emphasized the semantic component rather than the syntactic component, a synthesis approach rather than an analysis approach, and a number of linguistic units rather than a single linguistic unit, have had a significant influence on the development of reading theories (Pearson, 1981). Somewhat concurrently, another competing model has evolved, the information processing model. It will be discussed next.

Information Process Model

Information processing theory has been used in the field of linguistics, psychology, and reading, in order to simulate procedures

involved in the comprehension process of oral or written language so that more adequate models might be developed. Athey (1971:65), has described information processing as a theory operating on the same basis as an open computer system. It

. . . has as its components an input system, channel capacity, a storage system, programs for coding information to be stored, and an output system. Open systems contain sub-systems, which can be compared to a human being's memory capacity or storage.

Numerous linguistic theories (Hayes and Clark, 1970; Kelly, 1967; Lindsay and Norman, 1972; Mandler, 1967; Miller, 1969; Quillian, 1969; Trabasso et. al., 1970) have been discussed in the literature which clearly demonstrates the diversity of opinion which prevails on how the human information processing system works. One major problem with information processing theory appears to be the problem of accounting for the differences between computers and people (Reitman, 1970). On the positive side, however, more detailed and more specific psychological assumptions can be empirically tested in simulated computer programs. Thus, the interrelationships between language and memory can be studied more extensively (Athey, 1971).

Chase and Clark (1972), Frederiksen (1975), Rumelhart (1976), Trabasso (1972), and others, have generated theories which describe reading as information processing. Within these theories, the linguistic influence is illustrated by the inclusion of numerous basic concepts identifiable in linguistic research. Some researchers have focused on the relations among ideas in text, while others have focused on the relations among ideas stored in the human memory (Pearson, 1981). Some of these basic concepts such as redundancy, feedback, and storage, have had significant implications for both

the theorist and the educator. The concept of redundancy has directed reading research to examine material for the amount of redundancy needed to reduce the alternatives for prediction of upcoming words. And further, it has assisted educators in becoming more cognizant of the need to teach differing semantic and syntactic patterns within varying types of material. Secondly, the concept of feedback implies that educators should provide for students, instruction on how to use and monitor their feedback mechanisms (visual, auditory, syntactic, semantic, etc.) while comprehending text. Thirdly, and directly related to the purpose of this study, is the concept of storage, for as Athey (1971:96) has concluded:

Most computer programs that simulate human language processes emphasize the importance of a "dictionary list" or vocabulary storage. This implies that the child needs a rich vocabulary of spoken and written words available for matching with new stimuli.

Consequently, determining which instructional methods are most effective for developing vocabulary for specified materials, appears highly important when viewing reading within the parameters of an information processing model. Next, the role of vocabulary and linguistic ability will be discussed.

Role of Vocabulary and Linguistic Ability

Recently, Hammill and McNutt (1981:15) used a "meta-analysis" approach to systematically review over 8000 coefficients to demonstrate the relationship of reading to particular construct categories. It was concluded that the two best correlates of reading are the abilities involved in graphic competence and spoken language (especially those pertaining to receptive abilities). Graphic competence was described

as all other aspects of written language (i.e. other than reading - the receptive form of written language) and spoken language abilities were described as "all the abilities related to the meaningful interpretation or use of spoken symbols". This study presents a somewhat unique view of the correlates of reading as it provides a means for viewing the role of vocabulary within the context of total language.

When vocabulary is viewed in isolation, as in the Stanford Achievement Test (1973) standardization procedure, the correlation between vocabulary sub-test and total achievement tests ranged from .79-.89. Thorndike (1973:62) has also provided evidence of this strong relationship. He reported median correlations of .71 (10-year-olds), .75 (14-year-olds), and .66 (17-18-year-olds) for 100,000 students across fifteen countries. He concluded that his results indicate "how completely reading performance is determined by word knowledge at different levels and in different countries" (Thorndike, 1973). Davis (1944, 1968) has provided empirical evidence to support the uniqueness of the reading, comprehension factor identified as "memory for word meanings" (Davis, 1944). Clark (1972) and Spearritt (1972) confirmed that knowledge of word meanings was a unique, identifiable skill.

The preeminent role of word knowledge has also been demonstrated in studies which have analyzed readability factors (Bormouth, 1966; Coleman, 1971; Klare, 1974-75). For example, in a study of the factors that make prose difficult to read, Coleman, (1971) investigated properties (morphological, syntactic, and semantic) of words and sentences. Although he found sentence complexity to be an important variable "any measure of word complexity (number of letters, morphemes, or syllables, frequency of usage) will account for 80% of the predicted

variance" (Coleman, 1971:184). In a review, Klare (1974-75) also reported the word variable as more highly predictive of difficulty than the sentence variable. One aspect of word complexity, frequency of usage has been well documented. Thorndike and Lorge (1944), Carroll et. al. (1971), and others have provided substantial evidence to support the concept of variation in frequency of usage of the word variable at different levels and in different content areas.

A number of studies have been cited, based on correlational research, factor analytical studies, variables affecting readability of materials, and research pertaining to the word frequency variable. On the basis of this research, it has been concluded that "measures of vocabulary knowledge are potent predictors of linguistic ability" (Anderson and Freebody, 1981:77).

In summary, the influence of linguistic theories on the process of reading has been demonstrated in the literature. The psycholinguistic approach to developing reading models, or theories, have shifted from those based on a totally nativistic linguistic view, to those based on a cognitive view of language comprehension. As a result of the influence of transformational-generative grammar, case grammar, and generative semantics, reading theoreticians have placed more emphasis on the role of semantics. The emergence of information processing models has resulted in more reliable data obtained from more indepth studies based on the interrelationships between language (spoken and written) and memory. It has long been accepted that vocabulary has a strong relationship with the ability to comprehend text. Consequently, vocabulary development and semantic processing are viewed as important theoretical and pedagogical concerns in the teaching of reading. For

as Adams (1980:23) says:

The meaning of a text is in the mind of the reader. The text itself consists only of instructions for the reader as to how to retrieve or construct that meaning. The words of a text evoke in the reader concepts, their past interrelationships and their potential interrelationships as defined by their semantic properties. The syntactic structure of a text help the reader to select among these conceptual conglomerates.

But he or she must also be able to access and organize the appropriate conceptual knowledge, and this depends on a variety of semantic knowledge and processes.

Vocabulary Development

Three methods of vocabulary development have been identified which are directly related to building up students' facility in learning vocabulary related to concepts which appear in their science textbooks. The three methods were identified as cloze, semantic mapping, and category matching. A final but related area of investigation which has provided insight into vocabulary development is that of text predictability. Two aspects of predictability which seem especially relevant to the purpose of this study are the word association variable and the word frequency variable. Research studies which have investigated the cloze method for the purpose of developing vocabulary will be discussed first. This section will be followed by a discussion of the semantic mapping and category matching methods and then studies dealing with the predictability of text will be reported.

Cloze Method

In 1973:279, Bortnick and Lopardo stated:

A major instructional advantage of the cloze procedure is that material which is prepared based on the technique draws on the language itself and so-called skills are not

taught in isolated language structures. The student is constantly exposed to the experience of handling the context of the reading material as well as the structured aspects of the language.

This view is in total agreement with how Robinson (1975:57) suggested vocabulary should be developed in content material. He feels "that vocabulary development must stress the acquisition of words and groups of words in large contextual language frames rather than isolated lists of words". As a practitioner, he also feels that science material is often written in a classification pattern and that, in order for students to attach meaning to unfamiliar words, they should be taught the specific strategies needed to unlock the ideas within this pattern of writing.

In a review of the literature pertaining to the cloze procedure as a teaching technique, Jongsma (1971) suggested future areas of research: use of context clues, vocabulary development, and reading in the content fields. Since that time, there has been considerable research concerning the use of the cloze procedure as a teaching technique. However, research studies are generally comparative which have made application of this procedure for the development of vocabulary, for reading in the content areas, or for both, one in conjunction with the other.

Aaronson (1973) and Ellington (1972) investigated the use of the cloze procedure to develop vocabulary at the post-secondary and secondary levels respectively. The results were not statistically significant for either study. But, in Aaronson's (1973) study, a difference in mean scores for the project developed cloze tests favoring those receiving the treatment was reported (7.75 and 8.50).

Unfortunately, the specified treatment time was not indicated. Conversely, in Ellington's (1972) study in which the investigator instructed the experimental group and the teacher instructed the control group, no absolute gains were reported for the standardized reading test used to assess vocabulary growth. However, the treatment time specified was fifty-five minutes daily for six weeks.

Pepin (1973) compared the cloze technique combined with high-interest, low readability reading materials, and language experience reading materials, to assess their effectiveness in improving word knowledge of fourth, fifth, and sixth-grade pupils in corrective reading classes. A group of ten teachers per group (3 groups) were assigned to carry out the instruction and seven corrective reading supervisors were appointed to insure consistency and maintenance of the cloze and non-cloze instructional programs. Following seven months of instruction, the findings based on a standardized reading test, indicated neither the cloze instruction or the comparative treatment were effective in increasing vocabulary.

Blackwell et. al. (1972) assessed the effectiveness of the cloze procedure as a method of teaching vocabulary when compared to the dramatization technique at the third and fourth-grade levels. The experimental treatments consisted of executing a series of cloze passages with an automatic deletion count of five while the control group met and executed a series of dramatizations utilizing the identical stories completed as cloze passages by the experimental group. The length of treatment was five weeks. The mean gain scores from the Stanford Diagnostic Reading Test (SDRT), FORM W pre-and post-test scores indicated a statistically significant gain ($p < .05$) in

vocabulary for the group receiving the cloze instruction. The investigators concluded that the data seemed to indicate that the cloze procedure is effective in teaching vocabulary and further, it maintained student motivation over the five week period.

To summarize the analysis of the previously cited comparative studies, it appears that only the Blackwell et. al. (1972) study found a significant improvement in vocabulary development as a result of cloze instruction. However, Aaronson (1973) found some improvement, and the absolute gains in Ellington's (1972) study were not reported, so there may have been some improvement in vocabulary development. Conversely, Pepin (1973) found cloze instruction as well as the comparative treatment ineffective.

Variables such as type of criterion measure, length of treatment, instructor, and materials used, may have been factors which were partially responsible for the findings of these studies. For example, three of the four studies used standardized reading tests in which words are presented in isolation, or with limited context, to assess vocabulary taught within the larger contextual framework of the cloze procedure. As well, the one study (Blackwell et.al. 1972), which claimed significance, used the same form of the SRDT for pre-and post-test evaluation. In the Aaronson (1973) study, where some improvement was noted and a project developed criterion measure was used, the length of treatment was not reported. The length of treatment in the Pepin (1973) study was exceptionally long (seven months) and, although he accounted for the material variable, he did not consider the effect of the number of instructors and supervisors (37 in all) involved in the study. The Ellington (1972) study also had different instructors for the control and experimental treatment groups.

On the basis of these four studies, few conclusions can be formulated. It appears that the cloze procedure is ineffective in improving reading vocabulary. However, it also appears that extraneous variables have not been adequately controlled or reported and the criterion measures used to assess vocabulary growth may be insensitive to the cloze procedure treatments. A review of the cloze research studies which focus on discussion techniques and type of deletion may provide greater insight into the effectiveness of the cloze procedure as a teaching method for developing a vocabulary.

Both Stewart (1967) and Pessah (1975) made discussion an integral part of their treatments in studies which investigated integrating cloze instruction into college reading programs for the purpose of increasing vocabulary. Results in the Stewart (1967) study were reported as non-significant. However, the investigator suggested future research should involve matched pairs. In an earlier study reviewed by Rankin (1975), Bloomer (1962) found similar results and his findings were considered suspect as groups were not matched. Pessah's (1975) study focused instruction on examining selection deletions based on equally distributed types of context clues on which he based his discussion. The results indicated a significant difference favoring the cloze treatment. It was concluded that the data seemed to indicate deletions made selectively for the purpose of discussion and giving practice in using specific types of context clues resulted in increased vocabulary performance.

Heitzman and Bloomer (1967:223) employed two methods of measuring the effects of various deletion patterns within non-overt reinforced (no discussion) cloze procedure upon vocabulary at the grade nine level.

Although no significant differences were found as measured by the vocabulary section of the Iowa Test of Basic Skills, the noun deletions were positively correlated (.60) to the vocabulary sub-test while the modifier deletions were negatively correlated. The investigators concluded that "cloze procedure deletions, such as noun deletions, apparently offer more information and are more like conventional reading material than modifier deletions".

Cox (1974) also included discussion in a comparison of three instructional treatments on a stratified sample of disadvantaged fourth-graders to assess vocabulary growth. He varied the sequence and the type of discussion as well as the number of cloze completion exercises in each treatment group. The examiner concluded there was no significant difference between treatments and no interaction between treatments and reading ability.

Houston (1976) deleted every tenth word to compare whole word deletions with deletions which retained the initial letter. Subjects were disadvantaged sixth-graders and treatment time was nine weeks. According to the criterion measure (Gates McGinitie Reading Test), there was no significant difference between cloze and regular instruction in vocabulary and both treatments were found to be ineffective.

Inherent in these six studies, were many of the same problems which existed and were summarized in relation to the previously cited studies. Again, only one study (Pessah, 1975) out of the six reviewed, resulted in significant vocabulary growth. However, Cox (1974) failed to report absolute gains, Stewart (1967) failed to report criterion measure, and they (Stewart, 1967 and Bloomer, 1962) implied groups were not equal prior to treatment. Therefore, it is impossible to

assess the effectiveness of the cloze procedure as a method for developing vocabulary. Houston (1976) found both cloze and regular treatments ineffective and no significant differences were found in vocabulary development in the Heitzman and Bloomer (1976) study.

Other possible reasons for the reported findings may be due to discussion techniques and the nature of selected deletions. Three of the investigators included discussion within their treatments. Stewart's (1976) discussion was very general and it consisted of only fifty-five minutes prior to eight weeks of instruction. The type of discussion reported in Cox's (1974) study focused on context clues but in a global manner and he varied the sequence of the discussion with cloze completion exercises. Pessah (1975) focused his discussion on the specific context clues of direct explanation, indirect explanation, and inference from general sense of the story. Also, his passages were constructed by using selective deletions which were based on the same specified context clues. Houston (1976) and Heitzman and Bloomer (1967) did not include discussion in their treatments and, although they made selective deletions, they were based on either whole word or deletions which retained initial consonants rather than on types of context clues. Focus on noun deletions may have some merit according to Heitzman and Bloomer (1962). In view of Pessah's (1975) study, it appeared that research on cloze instruction for the purpose of developing vocabulary needs to explore in more depth, selective deletions in conjunction with related discussion which focuses on particular contextual relationships. Also, the problem of appropriate measures needs further investigation. For example, on closer examination of Pessah's (1975) study, it was found that vocabulary scores were never isolated and, consequently,

the conclusion that vocabulary had increased was based on a total reading score (vocabulary plus comprehension). Also, the same standardized reading test was given in pre-and-post-testing sessions. As well, other studies (Cox, 1974; Huston, 1974; Stewart, 1967; Heitzman and Bloomer, 1962) reported the use of standardized reading tests to assess vocabulary growth.

Sampson (1975) examined the effects of discussion in cloze instruction with third-graders to assess increase in vocabulary, comprehension, and divergent production performance. The treatment consisted of cloze completion followed by a teacher-led discussion which focused on the reasons why a particular response would, or would not, be acceptable in reference to the context around it. Both the control group and the cloze group worked in a basal reading series and reading centers. Divergent production was assessed by tallying the number of semantically consistent replacements, per deletion, for each treatment group. On the basis of this measure, it was concluded that cloze instruction was significantly more effective than reading centers for the purpose of increasing comprehension. Vocabulary development, as assessed by the Gates McGinitie Reading Test (GMRT), indicated the cloze procedure is as effective as, but not superior to, other techniques in the area of vocabulary development. Thus, the examiner concluded that the cloze procedure, as utilized in this study, is not necessarily recommended for vocabulary development.

Sampson's (1975) study has been cited separately, in order to discuss alternative methods for assessing vocabulary growth, as a result of cloze instruction. One alternative for assessing vocabulary growth might be an adaptation of the concept of divergent

production utilized in this study to assess comprehension. One study located in the literature supports this point of view. Byrne et. al. (1971:383) investigated the relationship of divergent thinking abilities with cloze performance through the use of tests based on Guilford's model of intellect. The tests selected focused on "the content of semantics and the products of classes, systems, and relations" as they seemed most appropriate to the process of completing cloze forms. The examiners concluded that the divergent thinking ability is positively related to cloze performance. As the word association test (Noble, 1952) is based on the concept of associational fluency, it may have been a more sensitive measure to assess vocabulary growth in Sampson's (1975) study than the GMRT from which he (Sampson) concluded that the cloze procedure, as utilized in his study, is not necessarily recommended for vocabulary development.

No studies were located in the literature which have directly employed the word association test for the purpose of assessing the effect of cloze instruction on vocabulary growth. However, Jongsma (1980:7) has suggested that evidence indicating the ineffectiveness of cloze as a procedure for developing vocabulary "may be a function of the way progress has been evaluated". A more positive conclusion cited by Jongsma (1980:7) indicates that cloze instruction appears to be useful "in helping students learn to read and understand content material". The following studies appeared to be more closely related to the present study so they will be discussed in more depth.

Grant's (1976) study is one which has focused on vocabulary development within the content area of social studies and appears to recognize the inadequacy of the Gates McGinitie Reading Test (GMRT)

as a measurement instrument. This study investigated the cloze procedure for improving sixth-grade students' vocabulary, reading comprehension, and knowledge of social studies. Although not specifically tested, discussion was an integral part of the cloze instruction which was prepared using social studies material. The results indicated no significant difference in vocabulary gain made by the experimental and control groups as assessed by the GMRT. The reported difference between means was not quite one raw score point (.9). A project developed cloze test and an informal social studies test were used to assess reading comprehension and knowledge of social studies. Results indicated no significant difference between cloze and regular social studies instruction on comprehension, but a significant difference favoring cloze instruction was found on the social studies test. Although the investigator concluded that cloze instruction appeared to enhance long-term recall of social studies material, she expressed two major concerns. One concern focused on the inadequacy of the GMRT for the purpose of assessing vocabulary development and the other concern focused on the interest level and motivational factors of the materials used for cloze instruction. She implied that, as the GMRT presents vocabulary in isolation and the cloze procedure relies heavily on context, it is not a good match and, therefore, more consideration of the measurement instrument may have changed the results. She also concluded that, on the average, scores fluctuated during treatment from thirty percent to fifty percent, depending upon the interest level of the material and the number of exercises completed. Interest level was observed in terms of the quantity and quality of discussion related to a topic and a related factor, motivation appeared to decrease as the number of completed cloze exercises increased.

Paige (1976) compared five cloze deletion variation with five seventh-grade social studies classes to assess increased vocabulary and knowledge of social studies content. The sample was stratified and included three achievement levels within each of the five types of cloze instruction. Deletion variations included: whole word deletion, first letter of deletion, first and last letter, all consonants, and four word multiple choice deletions. Ten words were selected for study each week (number of weeks was not reported) and were couched in prose selections taken from social studies content. A project developed test of vocabulary and content were used for the purpose of assessment. Results indicated no significant differences among achievement levels, or among the cloze approaches, as all approaches were effective. Significant correlations were reported between the vocabulary post-test and the content post-test and between the vocabulary delayed post-test and the content matter delayed post-test. In summary, the investigator concluded that the modified cloze overcame the differences among subjects of different reading levels for the purpose of vocabulary instruction in the content area of social studies.

Johns (1977) investigated four types of cloze deletion patterns to assess vocabulary growth in a stratified sample of fourth-graders. Through orientation sessions for those involved, efforts were made to systematize instruction and, through the use of readability formulas, efforts were made to control the difficulty level of the material. The investigator concluded that the problem of finding material at appropriate levels of difficulty resulted in available materials being basically science orientated and this may have promoted a lack of interest and motivation. He also indicated a need for more adequate control

of teacher effectiveness variables. Although no significant differences were found in vocabulary when measured by the Gates McGinitie Reading Test, he still viewed the cloze procedure as a potential teaching technique. Support for his contentions may have been a result of the finding that vocabulary development approached significance ($p = .06$) after eleven weeks of instruction but, after twenty-five weeks, the level of significance ($p = .54$) decreased. In conclusion, he suggested alternative teaching strategies (use of overhead for class discussion, and use of first letters in deletions) for future research.

Sinatra (1977) examined the effectiveness of the cloze technique for vocabulary development for high-risk second- - sixth-graders. The cloze activity was used daily as the culminating language arts activity in a program that associated word meanings with direct, lived experience. The cloze reading passages were based on four content areas, one of which was science and the deletions were almost always of the noun and verb class. Discussion focused on understanding which word was the most appropriate in a particular contextual setting. Effectiveness of the program was assessed by project developed cloze tests. The reported differences between pre-and post-vocabulary application, as measured by the Cloze Content Test, revealed significant gains at the .01 level of significance. The investigator suggested that, with only a five week difference between pre-and post-test, a partial conditioning effect may have accounted for an increase in vocabulary gain. However, he implied the increase was more likely a result of the consistent procedure of the program methodology. He further implied that future investigations should focus on close completion in specified content areas rather than including four content areas within one study.

In summary, both Grant (1976) and Paige (1976) have provided limited evidence which supports further investigation into the use of the cloze procedure for developing vocabulary in the content area of social studies. For example, Paige (1976) found a significant increase in both vocabulary knowledge and social studies knowledge, as well as significant correlations between vocabulary tests and content tests. He also found that the modified cloze overcame the differences among subjects of different reading levels. Although Grant (1976) found no significant difference in vocabulary development, she questioned the sensitivity of her measure, the motivational aspects of her materials, and the number of cloze exercises she administered in succession. However, vocabulary development through cloze instruction may have contributed to enhancing long term recall of social studies.

The cloze procedure may have potential as a method for developing vocabulary in the content area of science. In a search of the literature, no study was located which totally used science material to assess the effectiveness of the cloze procedure for developing vocabulary. However, Johns (1977) reported that his material was heavily concentrated in the field of science and Sinatra (1977) used science material one quarter of the time. Johns (1977) study approached significance ($p = .06$) at one point, however, he had numerous control problems and used the same measure as Grant (1976) for assessing vocabulary growth. The Sinatra (1977) study reported statistically significant results, however, the possibility of partial conditioning effects were indicated and the treatment was not exclusively the application of the cloze procedure. Further studies are necessary before any conclusions can be drawn as to the effectiveness of cloze instruction for the purpose of developing vocabulary in the content area of science.

In speculative conclusions drawn by Jongsma (1980:7, 9), he suggested that "cloze does not seem to be effective in improving vocabulary. However, this may be a function of the way progress has been evaluated . . . but . . . cloze instruction does appear useful in helping students learn to read and understand content material". He added further clarification in his review of the literature on cloze instruction: "It's impossible to assess what effect difficulty may have had on the studies reviewed" and thus, researchers need to be more cautious in matching cloze instructional materials with their students' abilities. Another instructional method which may have potential for developing vocabulary in the science content area is semantic mapping. It will be discussed next.

Semantic Mapping

The semantic mapping method of developing vocabulary has been described as the process of developing with students, a graphic representation (semantic map) which demonstrates the theoretical organization of a concept. This theoretical organization delineates the class, example, and property relationships which are attributable to concepts. Class and example relations are considered reciprocal (i.e. "animal" is the class to which "dog" belongs and "dog" is an example of the class "animal"), and the property relationship interacts with the class relationship. Consequently, the completed graphic representation of all these relationships is thought to be the manner in which our knowledge is stored in memory and is referred to as semantic maps (Johnson and Pearson, 1978). These authors have encouraged semantic mapping as a method of developing vocabulary. Few other references were located in the literature which directly discussed semantic mapping.

From a theoretical perspective, it appears that Pearson and Johnson's (1978) work is in agreement with the knowledge position as outlined by Freebody and Anderson (1981). Johnson and Pearson (1978) have described the development of meaning vocabulary as synonymous with the organization of reality into concepts. Support for this position comes from a position paper on vocabulary development (Carroll's definition of "concepts" cited in Block, 1976:180):

. . . concepts are properties or organismic experiences - more particularly they are abstracted and often cognitively structured classes of 'mental' experiences learned by organisms in the course of their life history.

As semantic maps are representative of this view, semantic mapping was proposed as a method of developing vocabulary for the purpose of expanding concepts.

The theoretical framework within which semantic mapping was formulated is in agreement with Carroll's definition. Collins and Quillian (1969), Lindsay and Norman (1972) and others, have outlined a theory of semantic memory which refers to "cognitively structured classes of 'mental' experiences" as semantic networks. Semantic networks are graphic displays which account for the functional relationships of the three relations: class, example, and property within a concept. These semantic networks are referred to as semantic maps by Johnson and Pearson (1978).

In the literature, this semantic memory theory (Collins and Quillian, 1969; Lindsay and Norman, 1972) has been classified as a hierarchical subset network model which emphasizes prestorage of information (Rumelhart, Lindsay and Norman, 1972; Shoben, 1981:313). Consequently, this model views "semantic memory as an interconnected

group of words connected in a graph-theoretic structure" (Smith et. al., 1974). Within the graph structure (semantic networks), concepts are represented as nodes and the relations of a concept are interconnected to the nodes by explicitly labelled ("isa") and directed links. Figure 2.1 is an illustration of a graph structure.

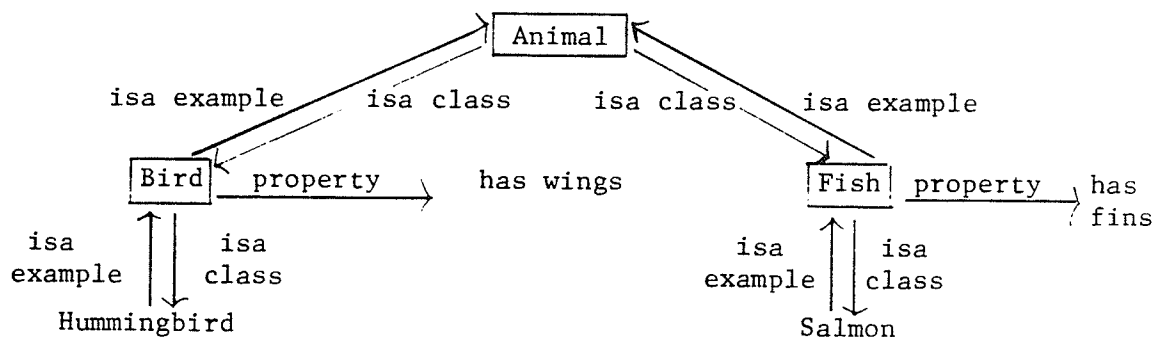


Figure 2.1 An incomplete graph structure (semantic network) representation of the concept animal.

Lindsay and Norman (1972) utilized Fillmore's (1968) case grammar, work on semantics by a number of modern linguists, and research on memory organization (Collins and Quillian, 1969), to develop and explain their theory of semantic memory. Basic to this theory is the graphic display of semantic networks (referred to as semantic maps by Pearson and Johnson, 1978) which reflect the number and kind of relations that can exist in the structure of memory. A more indepth discussion of this model will be presented next.

Lindsay and Norman (1972) have described a human memory system as one which simulates a computer and may be graphically displayed in semantic networks. This memory system is divided into two parts: the data base -- the structure where the information is actually stored, and the interpretive process -- the system that uses the information stored in the data base. The purpose of the data base is to encode

and remember concepts and events and complex interrelationships. The basic structural element of the data base is a set of nodes interconnected by a relation. A relation is an association among nodes and has two important properties; it is labelled and it is directed. The interconnecting nodes of a relation has distinctive meanings dependent upon the direction in which the relation is travelling. Thus, if a relationship specifies a superset relation (i.e. Bird) the inverse relationship would specify a subset relation (i.e. Robin). All nodes are named and Lindsay and Norman make the distinction between a word and a concept as being a primary and secondary node - - neither need have a natural language equivalent.

The interpretive process, the system that uses the information stored in the data base is responsible for evaluating inputs into memory, for storing new information, and for retrieving information. The processing and retrieval strategies are similar to the concept of generalization discussed in a theory of memory organization presented by Quillian (1967, 1969) and further investigated by Collins and Quillian (1969). The generalization procedure, when acting on a concept retrieves all the known examples of the concept and examines the associated information looking for common characteristics. If there is a sufficient number of common examples (with no contradictions) then the characteristic is added to the general characteristics of the class of concepts. Subdivision occurs if there is conflicting information associated with the example set. Subdivision causes a restructuring of the networks and inserts an intermediate level concept between the general concept and its examples. These intermediary concepts are those referred to earlier as the secondary concepts. Thus, only

unique properties need to be entered as all general properties already exist at the superset node. Consequently, these abstraction principles allow for generalization to occur in multiplicity of classes. The ability to generalize organizes the memory in such a way as to minimize storage space.

Pearson and Johnson (1978:35) have summarized these theoretical positions and have presented the view that:

. . . words are rather arbitrary labels within a language for concepts which are symbols for general classes of objects of events which share common elements or relationships. Concepts are derived from repeatable, segmentable reality which is composite of one's internal and external experience. Thus the relation between vocabulary expansion and experiential growth is parallel and inseparable.

Therefore, any effort to develop vocabulary for the purpose of expanding concepts must focus on the integration of old and new concepts. Pearson and Johnson (1978:25) have proposed semantic mapping as a "schematically rather than randomly organized" method for accomplishing this purpose.

A search of the literature has provided theoretical support (Collins and Quillian, 1969; Lindsay and Norman, 1972) for using the method of semantic mapping to develop vocabulary for the purpose of expanding concepts. However, no research studies were located in the literature which investigated the effectiveness of semantic mapping as a method for developing vocabulary. Consequently, it appears that empirical investigations of a practical nature are necessary to probe the effectiveness of semantic mapping as a method for developing vocabulary.

Category Matching

According to Bruner, Goodnow, and Austin (1956), Piaget, (1952) and Vygotsky (1962) categorization is involved in concept formation.

Bruner et. al. (1956:244) have suggested that "the working definition of a concept is the network of inferences that are or may be set into play by an act of categorizing". Thus, "to categorize is to render discriminably different things equivalent, to group the objects and events and people around us into classes, and to respond to their class memberships rather than their uniqueness". Consequently, by categorization, the unfamiliar becomes familiar, and one can generalize about an object based on knowledge about its category. These authors have written extensively about the central role of categorization in the process of learning and, therefore, provide theoretical support for the implementation of categorization as a teaching strategy. Category matching, a teaching method based on categorization, may be used in the process of developing vocabulary in one of two ways: through isolated words, or through words in context. Here, context may refer to sentence, paragraph, several paragraphs, a complete composition or numerous compositions. Two known sources have described categorization activities for developing vocabulary with reference to isolated words: Durrell et. al. (1975) and Johnson and Pearson (1978). Sources which have viewed categorization procedures within the larger contextual framework of language are Gerhard (1975), Henry (1974), and Robinson (1975).

Pearson and Johnson (1978:61) "believe that classifying is the most common and certainly one of the most important forms of human thinking". These authors have provided the same theoretical support for category matching as they did for semantic mapping. Although category matching as a method for developing vocabulary is viewed by them as one which is less structured and, therefore, not requiring a

hierarchical schematized organization. However, they do see it as an activity which may help children to develop a meaning vocabulary. Consequently, new vocabulary may be assimilated when the class of things to which a new word belongs is identified. The activity referred to as "category match" in Johnson and Pearson (1978) has suggested writing two or three categories at the top of the page and scrambling several words for each category below them. The activity requires the children to move the words to the appropriate category. No research studies were cited to support its use.

Durrell et. al. (1975:5) have published a Vocabulary Improvement Practice (VIP) kit in which children are required to unscramble isolated words and place them under appropriate category labels (as Johnson and Pearson's category match). This program includes 120 categories of words at each of four levels (40 cards per level with three categories per card). The words and categories were selected and organized through the use of three well known references: Spontaneous Speaking Vocabulary of Children in Primary Grades (Murphy, 1957), American Heritage Word Frequency Book (Carroll et. al., 1971), and Roget's International Thesaurus (Crowell, 1962). The authors stated that VIP was designed "to facilitate the mastery of phonics application, to increase the speed of word recognition, and to facilitate the meaning-imagery carrying power of words, assuring continued growth in reading". The primary instructional goal of the first two levels was to teach students to recognize spoken words through phonics and transfer words from speaking to reading vocabularies while the major goal of the third and fourth levels was the acquisition of new vocabulary. These authors have concluded that, through classification by

meaning, categorization increases "imagery-evoking" qualities and decreases an "over-concern with decoding". Thus, the implication was that, through VIP, word recognition becomes automatic, therefore, a large sight vocabulary is established which, in turn, "evokes the intended imagery" of words and results in the development of a meaningful vocabulary. Two studies (Catterson, 1959; Spencer, 1958) are cited to support the use of the program. Catterson (1959) investigated inductive and deductive methods of word analysis at the grade five level and Spencer (1958) evaluated word study lessons at the grade four level. The authors of the program (Durrell et. al, 1975: 23) concluded, on the basis of these two studies and "experience gained in over a thousand classrooms", the VIP "will improve achievement in reading, spelling, and word analysis.

Classification viewed in one of its broadest perspectives has been presented by Henry (1974) in his book: Teaching Reading As Concept Development: Emphasis On Affective Thinking. The focus of his book is an investigation into reading as an act of synthesis. Thus, according to Henry (1974:4) teachers must understand that:

Reading for concept development may be defined as making one's way through printed and written language in such a manner as to seek out a number of relations and to put this growing set of relations into a tentative structure.

Therefore, synthesis involves the discovery of relations and the invention of structure. Necessary correlates to the process of discovery and invention for the purpose of developing concepts are four operations: the act of joining, excluding, selecting, and implying. Piaget (1957) has described these same operations as: negation, conjunction, disjunction, and implication. Henry (1974:16) concluded

that "the total movement of these operations is the logical process in the discovery and the invention of structure called classifying". And, finally, Henry (1974:40) indicated that few educators have investigated classification based on learning theory for the purpose of developing concepts. He further emphasized that:

Concepts are not first made clear and accurate in order to be used later on in reading - in a definition or a dictionary or a vocabulary drill - divorced from a progressive development of the concept . . . They are made clear and accurate through reading and doing art and science, particularly by reading literature, by continually performing throughout our school days certain operations on and with language.

Based on empirical evidence of Inhelder and Piaget's (1958) stages of development in logical thinking, Gerhart (1975: ix) has presented practical ideas for grades six, seven, and eight teachers for developing with students, conscious "indepth categorization skills, translating categories into paragraphs, or the reverse, and organizing items within paragraphs within larger units". This author has indicated that reading is an active process which involved integrating many different skills and this process involves both oral and written language experiences. It further appears that this integration takes place in the following sequential manner. Letters are translated into sounds, sounds into words, and words into mental images. Beyond this process, attention is directed to structure of text (i.e. print, capitalization, punctuation) and awareness of relationships between ideas.

Gerhard (1975) has suggested that new words may be categorized into three groups: basic words, important but not basic words (including spelling groupings) and detail words (subordinates), which belong to the basic words (superordinates). The categorical relationships among the three groups are stressed until students reach a stage where

they habitually and consciously categorize material. Three possible techniques for finding categories in reading were suggested: students find items for a given label by reading, make up labels for groups of familiar items without reading, then check them in a book, and present an incomplete category with a label and two items and ask for additional items.

Gerhard (1975: xi) reported application of these approaches in open and traditional classrooms with seventh, eighth, and ninth-graders and with numerous classroom teachers. The investigator concluded that, although attitudes of very competent students were initially condescending to the earlier steps of the process, in the final stages, they expressed appreciation for learning a system of categorization. At the other end of the continuum, poor students were "able to learn roles of a topic and other sentences and could complete a short formal essay".

One experimental study (Gipe, 1978) was located in the literature which investigated the effectiveness of a category method for developing vocabulary with third and fifth-graders. The treatment was similar to a technique described by Gerhard (1975). The category method treatment consisted of one target word and three familiar words. Students were required to study and list, add words to each list, and to recategorize a random listing without reference to the study lists. The investigator attempted to control the word difficulty variable by reference to a word frequency book (Carroll et. al., 1971) and a vocabulary inventory source (Dale and O'Rourke, 1976). The examiner reported that use of category labels was not as effective as some other methods of vocabulary development, nor was it strongly supported by the experimental results.

Robinson (1975) has suggested that vocabulary development might be more successfully achieved by providing an explanation of specific writing patterns in specific content materials and then focusing instruction on strategies which would assist the reader in unlocking the ideas within each pattern. He has further suggested that one of the major writing patterns in science is the classification pattern, which often spans a considerable portion of a chapter. Three teaching strategies are recommended for teaching this pattern: recognition of a divided topic, recognition and assignment of subtopics, and understanding the classification scheme. Throughout the implementation of these strategies, students might be encouraged to make and analyze a classification chart. Practice at the paragraph level should be provided so students gain a thorough understanding of the pattern prior to proceeding to analyze larger units of this writing pattern. In conclusion, Robinson (1975:124) has stated that instructional procedures for developing vocabulary in science, need to focus on significant reading tasks and, therefore:

Concentration on the organization of the ideas should help the learner approach a difficult reading assignment with some semblance of confidence. No other approach makes any sense in a discipline that is dedicated to structure and order.

In review, the literature reported in the section on category matching is largely theoretical and based on categorization in general, rather than category matching specifically. If the literature on categorization were viewed on a hypothetical continuum, isolated vocabulary would be at one end, and vocabulary in total context at the other. Johnson and Pearson (1978) and Durrell et. al. (1975) would be seen at the end of the continuum where vocabulary is developed in isolation

from context. Gerhard (1975) would follow but extend through to the opposite end as his sequential process of categorization spans the total spectrum. Henry (1974) would be seen at the concluding end of the continuum where vocabulary development is viewed within the total context of language and concept development. Robinson (1975) would fall into the middle of the classification continuum for developing vocabulary and his view would include specifications with respect to writing patterns and content material.

Evidence has been presented which demonstrates that a total view of reading (subskill approach or holistic approach) has definite implications for how categorization strategies should be applied to vocabulary development for the purpose of expanding concepts. Descriptive, practical studies have been cited, which provide insight into the role of categorization and the reading process. However, only a small number of empirical studies appear in the literature. Research studies could not be located which addressed the particular manner in which this study viewed categorization within the theoretical framework presented by Johnson and Pearson (1978). However, the procedures for implementing category matching as a method of vocabulary development were modified so that science vocabulary was presented within the context of continuous text written in a classification pattern (Robinson, 1975). Consequently, an investigation into the method of category matching, as viewed in this study, appears warranted.

Text Predictability

In an effort to establish ecological validity, this study placed the target vocabulary within the context of continuous text, so that it might more closely parallel the reading situation. However, as

the purpose of the study was to investigate four instructional methods of developing vocabulary, efforts were made to control the readability of the material. The readability factors considered were word frequency, word association, and passage structure. Readability research has suggested that these factors contribute to the variability in the redundancy of written language, making text more or less predictable. Consequently, studies which have investigated the word variable may provide further insight into vocabulary development presented within the context of continuous text.

Coleman (1971), Marks et. al. (1974), and Wittrock et. al. (1975) investigated the effect of the word frequency variable within passages. Coleman (1971:184) found "any measure of word complexity (number of letters, morpheme, or syllables; frequency of usage) will account for 80 % of the predicted variance". In Wittrock et. al. (1975:485), the Marks et. al. (1974) study was cited. Children in three different experiments were required to read passages where high frequency words were inserted into an unfamiliar story. The treatment was reported to have "greatly enhanced sentence comprehension and retention".

Wittrock et. al. (1975) investigated the effect of high-and low-word frequency versions of reading and listening passages on vocabulary development with a stratified sample of fifth- and sixth-graders. The passages were constructed by holding constant the syntactical structures and substituting fifteen per cent of the nouns, adjectives, verbs, and adverbs with comparable words of high and low frequencies. The frequency values of the substituted words were obtained from the Carroll et. al. (1971) word frequency book. The findings indicated

that high frequency passages markedly facilitated vocabulary development for the low, middle, and high reading levels. The investigators concluded that this procedure has practical utility for teaching vocabulary.

Samuels (1968) conducted an experiment with fifth-and sixth-graders, as well as with college students, to assess the effects of paragraphs embedded with high or low associative words on reading speed, recall, and guessing behavior on comprehensive questions. The findings indicated that reading speed was significantly lower for paragraphs embedded with high associative words, recall was significantly better, and a very high portion of high associative alternatives were reported in the guessing behavior.

Froese (1978-79:268) formulated sentences through associative chaining in which the subject represented the focus of the sentence and each of the other elements was a primary associate of the subject. Through the use of these sentences, he investigated the quality, direction and distance of within-sentence contextual constraints with sixth-graders. Some findings reported were: "The associativity factor was highly significant"; there was more variability in response to low associative sentences than to high associative sentences; syntactically correct responses produced more synonymous responses and over fifty percent "of the incorrect responses fell into the same semantic category as the deleted word". Implications, as reported, suggest the findings appear to be consistent with Clark's (1970) theory of association and the one study previously cited by Samuels (1968). The investigator suggested that, in educational practice, the development of word meanings might be facilitated by encouraging

students to freely associate words in response to a stimulus word and to classify them according to Lindsay and Norman's (1972) semantic networks.

In summary, this section has indicated that the word variable (frequency and associativity) is a significant factor affecting the variability in redundancy and sequential constraints in written language and these factors may have implications for how educators develop vocabulary for the purpose of expanding concepts. The present study attempted to control the word variable within passages. The target vocabulary was presented within a highly predictable structure (a classification pattern) based on specified science concepts. Therefore, both redundancy (pattern and frequency) and associativity (class relations) in written language were considered. Also, the instructional methods for developing vocabulary and the criterion for measurement were viewed within a semantic perspective both in terms of linguistic and cognitive theory.

Summary

A review of the literature has revealed that reading theories have been significantly influenced by linguistic theories. The psycholinguistic approach to developing reading theories or models, have shifted from those based on a totally nativistic linguistic view, to those based on a cognitive view of language comprehension. As a result of the influence of transformational-generative grammar, case grammar, and generative semantics, reading theoreticians have placed more emphasis on the role of semantics. The emergence of information

processing models has resulted in more reliable data obtained from more indepth studies based on the interrelationships between language (spoken and written) and memory. The literature has demonstrated that vocabulary has a strong relationship with the ability to comprehend text. Consequently, vocabulary development and semantic processing are viewed as important theoretical and pedagogical concerns in the teaching of reading.

Research regarding the effect of the cloze procedure on improving reading vocabulary is not clear and requires further study before any conclusions can be drawn as to the effectiveness of this instruction. In a number of studies reviewed it appeared that extraneous variables have not been adequately controlled or reported, and the criterion measures used to assess vocabulary growth may be insensitive to the cloze procedure. In a search of the literature, no study was located which totally used science material to assess the effectiveness of the cloze procedure for developing vocabulary.

A search of the literature has provided theoretical support (Collins and Quillian, 1969; Lindsay and Norman, 1972) for using the method of semantic mapping to develop vocabulary. However, no research studies were located which investigated the effectiveness of semantic mapping as a method for developing vocabulary.

The literature has demonstrated that a total view of reading (subskill approach or holistic approach), has definite implications for how categorization strategies should be applied to vocabulary development for the purpose of expanding concepts. Descriptive studies have been reviewed which provide insight into the role of categorization and the reading process. However, only a small number of empirical studies appear in the literature.

Research studies which have investigated the word variable, in terms of frequency and associativity, indicate that these factors may have implications for how educators develop vocabulary for the purpose of expanding concepts.

The review of the literature has demonstrated that current research in reading has focused on the interrelationship of language (oral and written), memory structure, and the interaction of the learner with text. However, a limited number of empirical studies are available which test the effectiveness of the cloze, semantic mapping, and category matching teaching strategies for the purpose of developing science vocabulary. The need for further research has been expressed in the literature (Anderson and Freebody, 1981; Jongsma, 1980; Jenkins and Pany, 1981).

The purpose of this present study was to investigate the differential effects of four instructional methods for developing sixth-grade science vocabulary. The methods were identified as the cloze method, semantic mapping, category matching, and story discussion.

Chapter 3 will present a description of the sample, the design of the study and the research procedure and materials used in the study.

Chapter 3

DESIGN AND PROCEDURE

The purpose of this study was to investigate the differential effects of four instructional methods of developing sixth-grade science vocabulary. The four methods were identified as the cloze method (CL), semantic mapping (SM), category matching (CM), and story discussion (SD). The aim of each instructional method was to assist students in developing vocabulary related to specified science concepts. Three general questions were posed:

1. Do different instructional methods results in different word association scores when assessed by number of target words (i.e. words which were the focus of instruction) and by number of total words (i.e. other words in addition to target words)?
2. Do instructional methods with two science passages containing words which, on the average, are more familiar to grade six students (high frequency passages) result in greater gains than methods with two science passages containing words which, on the average, are less familiar to grade six students (low frequency passages) when word association scores are assessed by number of target words and by number of total words?
3. What are some qualitative differences among students' performances on word scores when examined for differences within treatment groups as measures by: the Durrell, total pre-test target words, total task scores and total post-test association scores, and the relationship between Durrell scores and total target word post-test scores?

The Study

Sample

The subjects in this study were 60 sixth-grade students selected from within four classrooms (two classes in each of two schools) within one Western School Division in rural Manitoba. Four groups of subjects were formed by matching procedures using Durrell vocabulary scores. Each intact group was randomly assigned to one of the treatments. The standardized test was the vocabulary listening subtest of the Durrell Listening - Reading Series, Intermediate Level, Form DE. This test was administered to all grade six students within the two schools.

Students were selected so the total raw scores for each group equalled 990 and the average was 66. The raw scores ranged from 36 to 86 thus the subjects were representative of a range of ability levels. The median score for each group was 67, 68, 69, 67 (see Appendix A).

Sixth-grade students were selected for the following reasons: (1) The role of contextual effects becomes more significant to the development of a meaning vocabulary when students enter intermediate grades and are faced with content material (Spache and Spache, 1977); and (2) grade six students are often the age at which students are in transition from a concrete personal view of the world to a more abstract, objective view (Inhelder and Piaget, 1958) and educators often assume this transition has completely taken place by the time the student begins grade seven.

The four treatments are briefly outlined below (more detailed lesson descriptions follow in this chapter):

1. Treatment One - Cloze. The subjects in this group were taught how to use context clues, structure of text, and beginning consonant clues to arrive at the appropriate response for target word deletions in cloze passages.

2. Treatment Two - Semantic Mapping. The subjects in this group were taught how to brainstorm from recall, target words in text, and how to classify target word responses in a hierarchical schematized structure.

3. Treatment Three - Category Matching. The subjects in this group were instructed to unscramble target words with use of a thesaurus or dictionary if desired and to place them under the appropriate labels provided for them.

4. Treatment Four - Story Discussion. The subjects in this group discussed ten general questions with the instructor and were then required to draw a picture about the passage content.

The groups received instruction for 30 minutes twice a week (one week per concept) for a total of eight lessons divided into two time blocks between May 19, 1981 and June 12, 1981. The standardized vocabulary test for establishing groups was administered before instruction began. Timed word association pre-tests were administered for the high frequency passages (animals and plants) one day prior to the first block of instruction. One day after instruction was completed for the first time block, an identical post-test was administered. The same procedure was followed before and after the second block of instruction based on the two low frequency passages (music and rocks) (see Figure 3.1).

High Frequency			
Pre-test		-----	
		Passages	
Time	Instruction	1	2
Block		Animal	(HF)
		Plant	(HF)
One			
Post-test		-----	
		Passages	
Low Frequency			
Pre-test		-----	
		Passages	
Time	Instruction	1	2
Block		Music	(LF)
		Rocks	(LF)
Two			
Post-test		-----	
		Passages	

The investigator administered the tests, developed the instructional materials (with the exception of three stories located in supplementary science material), and instructed the treatment groups.

Instructional Material

Grade six science texts were surveyed to locate science concepts which were taught at the grade six level. Four concepts were identified: animals, musical instruments, rocks and minerals, and plants. The first three concepts are presented in the text, Discovering With Science (Craig and Hurley) and the fourth is presented in Concepts In Science 6 (Brandwein et. al., 1966). Then, supplementary materials were surveyed to locate stories based on these concepts which were written in a classification pattern. Stories based on animals and plants, written in a classification pattern, were located in Be a Better Reader, Book I by Nila Banton Smith (1974). The titles of the stories were; "How Would We Classify John Gorilla?" and "To What Classification Does the Raintree Belong?". An appropriate story for the concept rocks and minerals, was found in Cambridge Work-A-Text, Science is Experimenting by Otho E. Perkin (1974) and was entitled "Rocks and Minerals Around Us". Appropriate material for the concept of musical instruments was constructed by the experimenter with reference to "What are the different kinds of musical instruments?" in Concepts and Challengers In Science 3 by Wolfe et. al. (1979) and "Musical Instruments" in The World Book Encyclopedia (1977).

For the purposes of this study, nouns which represented the superordinate categories and subordinate terms were selected from the above passages. These nouns became target words for the study and were underlined in the passages which the students read. The

various passages were: animals, plants, musical instruments, and rocks and minerals and the number of target words were 46, 32, 32 and 22 respectively.

The frequency values by grade and by content area (science) were obtained from The American Heritage Word Frequency Book (Carroll et. al., 1971). The frequency values were tabulated, totalled, and averaged for each passage, both for frequency of usage at the grade six level, and for frequency of usage in the field of science. The frequency values for each passage are included in Appendix B. The animal and plant passages were designated as high frequency passages based on the average frequency values calculated for the target words within the passages. The musical instruments and rocks and minerals passages were designated low frequency passages (see Figure 3.2).

A set of material was constructed for each concept for three treatment conditions: CL, SM, CM. The material for the S.D. treatment remained the same for all four concepts.

The cloze passages for each concept were constructed by paraphrasing the passages, deleting the noun target words, and providing deletions with initial consonants or blends, when two or more deletions were consecutive. An overhead transparency of each cloze passage was reproduced.

The semantic mapping instructional material was constructed by schematically organizing an exact number of boxes (for exact number of target words per concept) joined by two directed arrows labelled "isa" and "eg" to the superordinate category labels. The schematic structure was hierarchical in that the superordinate box was centered

Designated	Passages	Frequency Science	Grade 6
High	Animals	29.34	26.45
Frequency	Plants	35.25	27.12
Low	Music	1.71	10.25
Frequency	Rocks	10.36	4.65

Figure 3.2 Average Frequency Values For Passages Designated
High Frequency and Low Frequency

at the top of the page with directed arrows to the subsets, and further to examples of the subsets.

The category matching material was constructed by centering the superordinate label at the top of the page and the underlined subcategories below them. A blank space was left and the remaining target words were scrambled at the bottom of the page.

The instructional material for the story discussion treatment consisted of ten general questions which were prepared by the investigator. The materials used for instruction are reproduced in Appendix C.

Lesson Procedure

The lesson procedure followed one general instructional pattern for all treatments and for all passages. Each subject viewed a copy of the story written in a classification pattern in which the target words were underlined. The story was read orally to the subjects in each group by the examiner and their copies were collected prior to the instruction. This procedure was followed as a result of a concern for the readability difficulty factor as expressed by Johns (1977), Jongsma (1980), and Robinson (1975) in relation to content material.

The lesson procedure then varied according to the four treatment groups: CL, SM, CM, SD. Instruction for each concept spanned two lessons. The lesson procedure was identical for each concept within each treatment group. The degree of exposure to context was controlled by the number of times the students saw the target words in context. The lesson procedure for each treatment is elaborated in the following pages.

1. CL Teaching Procedure. The lesson procedure was similar to that suggested by Johns (1977). In the first lesson, the general instructional method was followed, students then received the cloze exercise. The students were instructed to completely read through the cloze exercise then complete it. The completed cloze exercises were collected at the end of the lesson. In the second lesson, the completed cloze exercises were returned to the students. An overhead transparency of an incomplete cloze exercise was projected onto the blackboard. Sentence by sentence, the cloze passage was read and students volunteered answers with an explanation of their use of: context clues, structure of text, and initial consonant or blend clues. These responses were written on the blank of the projected cloze exercise. The instructor, with constant reference to previous text and upcoming text, clarified and illustrated the appropriateness of a student's response. Responses were changed if requested. The entire cloze exercise was discussed in this manner. The blackboard was then erased and students received the original story once more. Students were requested to score their cloze exercise with reference to the original story and return both to the instructor.

2. SM Teaching Procedure. The lesson procedure was an adaptation of the teaching strategy suggested by Pearson and Johnson (1978). In the first lesson, the general instructional method was implemented. Students were then required to visualize the story and respond orally with words that came to mind. When students responded, they were asked if the words were at the beginning, middle, or end of the story. The instructor placed the words on the blackboard from left to right (beginning to end) or in whatever position the student

requested. As more words were provided, the instructor, with student direction, categorized them with respect to superordinate, subordinate, and subset (classes and examples). The instructor then placed boxes around the words and placed arrows so the structure was joined. The labels "isa" and "eg" were seldom written but often referred to in oral discussion. In the second lesson, students received the blank schematically organized semantic map and were required to complete it. When completed to the best of their ability, students received the original story to score their semantic maps. The students were then required to complete their semantic map in an alternate color of ink and return the materials to the instructor.

3. CM Teaching Procedure. The lesson procedure was, again, an adaptation of the teaching strategy suggested by Johnson and Pearson (1978). In the first lesson, the general instructional method was followed, and students were given the category matching exercise. Students were instructed to place the words under appropriate labels. The exercises were collected at the end of the lesson. In the second lesson, the incomplete exercises were returned to the students and they were required to complete them to the best of their ability, with the use of a dictionary or thesaurus, if they desired. The students were then given an answer key with the appropriate responses under the correct labels and requested to score their category matching exercises. When scored, the students were encouraged to complete their exercises with reference to the answer key, prior to returning the materials to the instructor.

4. SD Teaching Procedure. The lesson procedure was considered to be incidental rather than directed (Petty, Herold, and Stoll, 1968).

In the first lesson, following the general instructional method, ten general questions were discussed with the total group. In the second lesson, students were required to draw a picture which was representative of the passage they had heard and discussed in the first lesson. The students were requested to leave their pictures with the instructor.

Test Instruments

Durrell Listening-Reading Series

The Durrell was selected as a grouping measure in this study because it requires classification procedures similar to the ones used in the treatments. In a review (Bormuth in Buros, 1972; 7:728), the Durrell Listening-Reading Series has been recognized as one which has outstanding content validity among standardized vocabulary tests. Bormuth has indicated that its utility is derived from the fact that the authors have explicitly identified a significant segment of language: the vocabulary subtests are representative of semantic categories employed in Roget's Thesaurus and are representative of the frequency of appearance of words in instructional materials.

The test format of the listening vocabulary subtest is made up of eight sets, four categories in which twelve items are presented for matching with each set of four categories. One category within each set is related to a stimulus word given orally to one of four categories. Although the number of concepts measured are not numerous, it appears that this measure would be sensitive to the assessment of a student's ability to develop vocabulary for the purpose of expanding a concept.

In the present study, the matching technique was used for the purpose of equating groups. Gay (1981) and others have suggested that the measure selected for use in matching must be sensitive to the design and purpose of the study. Within the design of the study, the prescribed treatments involved tasks which are related to classification ability. It was, therefore, deemed necessary to locate a measure which would match groups on their ability to classify. For this reason, the Durrell Listening-Reading Series, Intermediate Level, Form DE was selected.

Word Association Tests

A word association test was constructed for this experiment as a dependent measure to assess the effect of four methods: CL, SM, CM, and SD, for the purpose of developing vocabulary (see Appendix A). Jongsma (1980) has suggested that, in order to assess the effectiveness of instructional strategies, the criterion measure must be closely aligned with the instructional methods used.

In the present study, the initial treatment for each group was based on a common set of instructional materials. All groups received the same four passages written in a classification pattern. Thus, each of the four passages had a topic, subtopic, and examples of each subtopic. In order to easily comprehend this structure, it requires the subject to associate examples with appropriate subtopics. Therefore, word association was considered a part of this process.

Also, three of the specified treatments involved word association skills. The CL instructional material required students to complete several deletions in succession which were examples of a particular class. And Bryne (1971) has found a high correlation between

cloze performance and "associational fluency". The treatment of SM was the development of a schematic network of word associations and for CM it was the association of words to appropriate categories (Lindsay and Norman, 1972; Johnson and Pearson, 1978). Consequently, it was felt that the word association test was closely aligned with the instructional methods.

In the present study, timed (2 minutes) word association tests were used as pre-and post-tests in order to obtain a more sensitive measure of the subjects' vocabulary development before and after experimental treatments. The word association test (WAT) provided the investigator with the number of target words already known about a concept prior to treatment, so actual vocabulary gained as a result of treatment could be assessed.

The Pilot Study

A pilot study was conducted to investigate the practical application of the semantic mapping method for developing vocabulary and to provide direction in planning the present study. The study was, for the most part, descriptive.

The subjects for the pilot study were seventh-grade students in two classrooms in one school in Western School Division in rural Manitoba. The students were selected and matched across two groups (8 students per group) on the basis of Stanford Achievement Test, scores administered in September, 1980. The grade equivalent scores for the vocabulary subtest ranged from 6.8 to 8.5 in each group. Treatments were randomly assigned. All students in each class participated.

The two experimental treatments were: semantic mapping and category matching. The instructional materials were developed with reference to categories outlined in Words To Use, A Primary Thesaurus (Drysdale, 1971). Three categories were selected: feelings, farming, and clothing. The semantic mapping material consisted of the superordinate label at the side of the page with a line drawn to each of the subcategory labels as provided in the primary thesaurus. Under each subcategory, space was provided so words could be placed under them. The category matching material consisted of one subcategory from each of the selected categories (i.e. words to describe feeling; caring for clothes; farm animals and birds) typed in red, with words from each subcategory scrambled below.

The lesson procedure for the semantic mapping method involved placing the superordinate of one category in the center of the blackboard and encouraging students to respond with associated words. The instructor then attempted, with students' assistance, to categorize and label the responses. Efforts were made to label the categories similarly to those used in the primary thesaurus. In the second lesson, students were required to complete the exercise developed for the semantic mapping method. The lesson procedure for the category matching required the students to work in groups of four, to unscramble the words listed under the subcategories and write them in three columns on a paper. This required both lesson periods for each of the three categories. A total of 12 class periods of 40 minutes each were required for each treatment.

A word association (WA) pre-test was administered on the three categories (2 minutes each) the day prior to instruction and a (WA)

post-test was administered on the three categories (2 minutes each) the day following the instruction. Total word association responses were counted for each concept on the pre-and post-tests. The difference between pre-and post-test scores was calculated. The total difference for the semantic mapping group for each of the three concepts (feelings, farming and clothing) was 2, -2, and -2 respectively. The total difference in the category matching group was 21, 19 and 31.

The pilot study provided numerous insights which assisted in the planning stages of the present study. First, the semantic mapping method, as implemented, was a very frustrating experience for both student and instructor. Plausible reasons for this frustration are listed:

- (1) The task required students to draw on their experiential background with no new information added.
- (2) The exercise was not clearly schematized in recognition of the theory upon which it was based (Lindsay and Norman, 1972).
- (3) The instructional procedure was too vague.
- (4) The categories selected were too broad and students were too familiar with them.
- (5) No specific target words were actually taught and the expected word associations spanned too many grammatical classes.

Secondly, as specific target words had not been selected, there was no other alternative but to score total word associations. This appeared to result in an assessment of experiential vocabulary with no direct assessment of the new vocabulary gained. Although the category matching treatment seemed adequate, the number of words these students studied was too many for the study time allotted. And, again, no new vocabulary gained could be assessed.

As a result of these insights the present study was planned. Primarily, attention was focused on constructing a more adequate semantic mapping task with specific teaching strategies outlined. Secondly, if theoretically, vocabulary development is viewed as part of the total reading process, then practical instructional strategies should develop vocabulary which is in the context of continuous text. Consequently, an appropriate contextual framework was selected. Thirdly, the specific vocabulary to be developed was identified. Fourthly, an assessment procedure was identified which would directly assess the vocabulary gained. In addition, the cloze treatment and story discussion (benchmark) treatment were added to the study, as it appeared that the semantic mapping and category matching treatments were very similar. Also added was the degree of exposure to context so treatments would vary in another aspect.

Analysis of Data

Design

The basic experimental design was a three way analysis of variance [treatment x passage x time (gain)] with repeated measures on one dependent variable with two levels, the pre-and post-word association tests. Following the analysis of variance, multiple comparison tests were computed to probe significant interactions. The rate of Type I error was controlled a $\alpha = .05$ by using the Tukey and Scheffé (Kirk, 1969) criterion of significance. More detailed descriptions of these procedures are presented in Chapter 4.

Hypothesis

The three general questions posed in this study will be presented with their accompanying specific hypotheses.

Question 1: Do different instructional methods result in different word association scores when assessed by number of target words (i.e. words which were the focus of instruction) and by number of total words (i.e. other words in addition to target words)?

Hypothesis 1.1 There are no significant differences in the mean target word association scores when considering the pre- and post-tests for treatments on science passages equated by overall frequency and organizational pattern.

Hypothesis 1.2 There are no significant differences in the mean target word association scores when considering post-tests on passages for CL, SM, and CM as compared to SD.

Hypothesis 1.3 There are no significant differences in the mean target word association scores when considering post-tests on passages for the SM group as compared to the CL, CM, and SD group.

Hypothesis 1.4 There are no significant differences in the mean target word association scores between pre- and post-tests on passages within treatment groups.

Hypothesis 1.5 There are no significant differences in the mean target word association scores between groups when considering pre- and post-tests on all passages when degree of exposure to context was greater within treatments as compared to when degree of exposure to context was less within treatments.

Hypothesis 1.6 There are no significant differences in the mean total word association scores when considering the pre- and post-tests for

treatments on science passages equated by overall frequency and organizational pattern.

Hypothesis 1.7 There are no significant differences in the mean total word association scores when considering post-tests on passages for CL, SM, and CM as compared to SD.

Hypothesis 1.8 There are no significant differences in mean total word association scores when considering post-tests on passages for SM group as compared to the CL, CM and SD group.

Hypothesis 1.9 There are no significant differences in the mean total word association scores between pre- and post-tests on passages within treatment groups.

Hypothesis 1.10 There are no significant differences in the mean total word association scores between groups when considering pre- and post-tests on passages when degree of exposure to context was greater within treatments as compared to when degree of exposure to context was less within treatments.

Question 2: Do instructional methods with two science passages containing words, on the average, which are more familiar to grade six students (high frequency passages) result in greater gains than methods with two science passages containing words which, on the average, are less familiar to grade six students (low frequency passages) when word association scores are assessed by number of target words and by number of total words?

Hypothesis 2.1 There are no significant differences in the mean target word association scores when considering pre- and post-tests for treatments with high frequency passages as compared to treatments with low frequency passages.

Hypothesis 2.2 There are no significant differences in the mean total word association scores when considering pre- and post-tests for treatments with high frequency passages as compared to treatments with low frequency passages.

Question 3: What are some qualitative differences among students' performance on word scores when examined for differences within treatment groups as measured by: the Durrell, total pre-test target words, total task scores, and total post-test association scores and the relationship of Durrell scores and total target word post-test scores?

More specifically the qualitative questions are:

Question 3.1 Are there differences in treatment groups as measured by the Durrell pre-test?

Question 3.2 Are there differences in treatment groups as measured by total pre-test target words?

Question 3.3 Are there differences on total task scores (scores on training tasks) and total post-test association scores within three treatment groups (CL, SM, CM)?

Question 3.4 What are the relationships between subjects' scores on the Durrell and subject's scores on total target word post-tests?

Summary

This chapter identified the subjects that comprised the sample for this study and described the procedure used to match groups and assign the groups to the treatments. The test instruments, instructional materials, and procedures were also described as well as the design of the study, methods of data analysis, and hypothesis.

A pilot study was conducted to investigate the practical application of the semantic mapping technique and to provide direction in planning the present study.

The statistical analysis and findings will be presented in Chapter 4.

Chapter 4

ANALYSIS AND FINDINGS

The purpose of this study was to investigate the differential effects of four instructional methods of developing sixth-grade science vocabulary. The four methods were identified as the cloze method (CL), semantic mapping (SM), category matching (CM), and story discussion (SD). The aim of each instructional method was to assist students in developing vocabulary related to specified science concepts.

The subjects in this study were 60 sixth-grade students. Four equal groups were formed by matching procedures and each intact group was randomly assigned to one of the four treatments. The subjects in one group were taught how to use context clues, structure of text, and beginning consonant clues, to arrive at the appropriate response for cloze deletions (CL). The subjects in the second group were taught how to brainstorm from recall, target words in text, and how to classify target word responses into a hierarchical schematized structure (SM). The subjects in the third group were instructed to unscramble words with use of a thesaurus, or dictionary if desired, and to place them under the appropriate labels provided for them (CM); and subjects in the fourth group discussed ten general questions with the instructor and were then required to draw a picture about the passage content (SD).

The initial lesson procedure followed one general pattern for all treatments and for all passages, then varied according to the procedures previously outlined. Each treatment group was exposed to

varying degrees of context, controlled by the number of times the students saw the target words in context. A set of materials was constructed for each concept for three treatment conditions: CL, SM, CM. The material for the SD treatment remained the same for all four concepts.

In presenting the data, first the main effects will be discussed with reference to the first general question. Next, the significant interactions will be presented. A general discussion will follow which demonstrates how the specific hypotheses were affected by the interactions. The second general question will be presented in the same sequence as the first. Lastly, a qualitative analysis of the third general question is presented with the specific questions which it generated.

Main Effects

The data was analyzed by applying a three-way analysis of variance (treatment x passage x time) with repeated measures on two levels of one dependent variable, the word association test. The .05 level of significance was selected for the acceptance or rejection of all statistical tests.

The treatment factor contained four levels -- CL, SM, CM, and SD -- to which matched groups were assigned randomly. The passage factor contained four levels -- animal, plant, music, and rock -- which were specified concepts within the grade six science subject area. The passages were controlled for overall frequency and organizational pattern. The time factor contained two levels -- pre-test time and post-test time.

General Question I

Do different instructional methods result in different word association scores, when assessed by number of target words (i.e. words which were the focus of instruction) and by number of total words (i.e. other words in addition to target words)?

To answer this question, the scores for total number of target words and the scores for total number of word associations were tallied and submitted to an analysis of variance. The ANOVA results for the target word analysis and the means and standard deviations are presented in Table 4.1. The results for the total word analysis are presented in Table 4.2.

The analysis of variance for target words showed that treatment, passage, and time (from pre- to post-tests) were significant factors affecting the target word association test [for treatment, $F(3,56) = 7.40, p < .05$; for passages, $F(3,168) = 121.82, p < .05$; and for time, $F(1,56) = 132.55, p < .05$]. The results indicate that there was a significant difference in the target word scores which was due to treatments. Secondly, the significant passage effect indicates there was considerable variation in experiential knowledge about different concepts and thirdly, treatment was effective in changing scores from pre-test time to post-test time. However, the following two-way interactions were also significant. Treatment and passage were significant factors between subjects within groups, resulting in a passage by treatment interaction [$F(9,168) = 2.82, p < .05$]. Treatment and time from pre- to post-tests were significant factors between subjects and within groups, resulting in a time by treatment interaction [$F(3,56) = 7.56, p < .05$]. Passage and time were significant

factors between subjects within groups, resulting in a passage x time interaction $[F(3,168) = 10.62, p < .05]$. In addition, the following three-way interaction was found: the treatment x passage x time interaction was significant between subjects within groups. $[F(9,168) = 5.42, p < .05]$. These interaction effects will be discussed following the presentation of the main effects for the analysis of variance for total words

The analysis of variance for total words showed that treatment was not a significant factor affecting the performance on the word association test $[F(3,56) = 2.22, p > .05]$.

Table 4.2 presents the results of the analysis of variance for total words. The analysis showed that treatment was not a significant factor affecting performance on the word association test $[F(3,56) = 2.22, p > .05]$. Passage, time, and a passage x treatment interaction were significant $[$ for passage, $F(3,168) = 84.40, p < .05$; for time, $F(1,56) = 55.34, p < .05$; and for passage x treatment, $F(9,168) = 2.52, p < .05]$. But, treatment x time, passage x time, and passage x treatment x time, were all non-significant interactions $[$ for treatment x time, $F(3,56) = 1.58, p > .05$; for passage x time, $F(3,168) = 1.24, p > .05$; and for passage x treatment x time, $F(9,168) = 0.89, p > .05]$. As there was no significant treatment effect, this method of analysis was not pursued any further.

Interactions

Following the analysis of variance, in order to interpret, more precisely, the interaction, post hoc comparisons among the cell means were carried out using Tukey's procedure. Three sets of pair

Table 4.1

Analysis Of Variance Performance
on Target Word Association For
Treatment, Passage, and Test Time

Source of Variance	Sum of Squares	df	Mean Square	F ratio	Level of Significance
Treatment (A)	725.783	3	241.927	7.40	0.000 *
Error Term	1830.583	56	32.688		
Passage (B)	2525.466	3	841.822	121.82	0.000 *
AxB	175.083	9	19.453	2.82	0.004 *
Error Term	1160.950	168	6.910		
Time (C)	2116.800	1	2116.800	132.55	0.000 *
AxC	326.416	3	120.805	7.56	0.000 *
Error Term	894.283	56	15.969		
BxC	128.466	3	42.822	10.62	0.000 *
AxBxC	196.650	9	21.850	5.42	0.000 *
Error Term	677.383	168	4.032		
* $p < .05$					

Target Word Raw Score

Means and Standard Deviations

Treatment	CL	SM	CM	SD
Pre-test MEAN	15.466	16.066	13.600	12.200
Pre-test SDev.	7.057	7.320	6.473	7.667
Post-test MEAN	33.733	41.466	31.333	18.200
Post-test SDev.	14.489	22.690	14.098	10.263

Table 4.2

Analysis Of Variance Performance
on Total Word Association For
Treatment, Passage and Test Time

Source of Variance	Sum of Squares	df	Mean Square	F Ratio	Level of Significance
Treatment (A)	791.816	3	263.938	2.22	.095
Error Term	6650.150	56	118.752		
Passage (B)	3556.883	3	1185.627	84.40	0.000 *
AxB	318.200	9	35.355	2.52	0.009 *
Error Term	2359.916	168	14.047		
Time (C)	529.200	1	529.200	55.34	0.000 *
AxC	45.250	3	15.083	1.58	0.205
Error Term	535.550	56	9.563		
BxC	33.850	3	11.283	1.24	0.295
AxBxC	72.500	9	8.055	0.89	0.537
Error Term	1524.650	168	9.075		
* p < .05					

wise multiple comparisons were computed to probe the target word treatment x passage x time interaction. The first set of multiple comparisons assessed the mean gains from pre- to post-test for each passage within each treatment. The second set assessed the mean differences within passages for a particular treatment and time combination. Thirdly, differences within treatments for a particular passage and time combination were assessed. The rate of Type I error was controlled at $\alpha = .05$, by using the Tukey criterion of significance. Thus, a difference was judged statistically significant if the absolute value of the difference exceeded the Tukey critical value (c.v.), that is $q/\sqrt{2}$.

1. Pre- to Post-Test Gains for Passage and Treatment Combinations

The results of the t-tests for pre- to post-test gains and a table of means for the passage x treatment interaction are presented in Table 4.3. The pre- to post-test gains for the CL treatment were statistically significant for all passages with the exception of the animal passage and the pre- to post-test gains for the SM and CM treatments were statistically significant for all four passages. The SD treatment has statistically significant gains for only the animal passage.

These findings indicate that the SM and CM treatments had a significant positive effect on all four passages when assessed by target words gained from pre- to post-tests. As the CL treatment was effective in all but the first passage, it may indicate that there was a practice effect operating within the CL treatment. The results for the SD treatment for the passages; plant, music, and rock,

Table 4.3

A Comparison of Mean Target Word Scores and t-Values
for Pre- to Post-Test Performance for
Particular Passage and
Treatment Combinations

Treatment	Time	Passage		Plant	SD	Passage		Rock	SD
		Animal	SD			Music	SD		
CL	Pre	4.000	1.732	2.333	1.496	8.666	3.086	0.466	0.743
	Post	5.666	2.093	8.466*	4.454	12.333*	3.658	7.266*	4.283
	t-value	1.723		6.343*		3.792*		7.032*	
SM	Pre	3.000	2.267	2.866	2.166	9.066	2.051	1.133	0.833
	Post	7.600*	6.511	12.400*	7.179	13.400*	4.732	8.066*	4.267
	t-value	4.756*		9.859*		4.481*		7.169*	
CM	Pre	3.200	2.210	1.866	1.457	7.466	1.922	1.066	0.883
	Post	8.200*	4.345	8.066*	3.594	10.000*	2.976	4.866	3.181
	t-value	5.170*		6.411*		2.620*		3.929*	
SD	Pre	2.866	2.559	2.266	1.437	6.466	2.614	0.600	1.055
	Post	5.200	2.624	2.800	2.808	8.066	2.631	2.133	2.199
	t-value	2.413*		1.654		1.654		1.654	
c.v. at $\alpha = .05$ for $df = 32, 86 = 2.286$									

did not have a significant effect on target words gained from pre- to post-test. The t-values are relatively much lower than in the other treatments on these three passages which may have been the result of inadequate focus on the target words during instruction. However, the results for the SD treatment had a significant effect on target words gained from pre- to post-test on the animal passage. Thus, the lack of significant gain in the following three passages may have been a result of the lack of variation of the tasks involved in the instruction.

2. Differences Within Passages For Treatment and Time Combinations

The results of the t-tests for differences within passages for treatment and time combinations are presented in Tables 4.4 (A and B). The means and standard deviations are included in Appendix D. The results of the t-tests indicate that there was little consistency in the significance within passages for treatment and time combinations. This inconsistency may be due to the frequency variable and the role of personal experiential background.

If the frequency variables were operating effectively, the two designated high frequency passages (animal and plant) would have revealed no significant difference in post-tests within treatments, when compared individually. The same generalization would also apply to the low frequency passages (music and rock). The results indicate when a comparison is made between the high frequency passages (animal and plant), that significant differences exist in the post-test for both CL and SM treatments. A comparison of the low frequency passages reveals results which indicate significant differences in all post-tests

Table 4.4 (A)

A Comparison of t-Values For Different Passages
For Particular Treatment and Time Combinations

Treatment	Animal vs. Plant		Animal vs. Music		Animal vs. Rock	
	Pre	Post	Pre	Post	Pre	Post
Frequency	HF	HF	HF	LF	HF	LF
CL	1.950	3.278*	5.464*	7.806*	4.138*	1.873
SM	0.156	5.620*	7.103*	6.791*	2.186	0.545
CM	1.562	0.156	4.995*	2.107	2.498	3.903*
SD	0.702	1.170	4.215*	3.355*	2.653	3.591
cv at $\alpha = .05$ for $df = 9,314 = 2.817$						

Table 4.4 (B)

A Comparison of t-Values for Different Passages
for Particular Treatment and Time Combinations

Treatment	Plant vs. Music		Plant vs. Rock		Plant vs. Rock	
	Pre	Post	Pre	Post	Pre	Post
Frequency	HF	LF	HF	LF	LF	LF
CL	7.416*	4.528*	2.186	1.639	9.367*	5.933*
SM	7.259*	1.170	2.029	5.074*	9.289*	6.245*
CM	6.557*	2.264	0.936	3.747*	7.494*	6.011*
SD	4.919*	6.166*	1.950	0.781	6.868*	6.947*
cv at $\alpha = .05$ for $df = 9,314 = 2.817$						

within all treatments. Consequently, a comparison between a designated high frequency and a designated low frequency passage has many inconsistencies. Possible reasons for this variability may be due to the manner in which these passages were designated high or low frequency or the frequency factor may have been confounded by the attempt to parallel the writing pattern within each passage (the classification pattern).

The overall frequency within passages was determined by averaging the frequency values of the selected target words. Thus, the variability among individual word frequency values was, in some cases, very great. For example, within the plant passage, the word "cones" had a grade six frequency value of 6, while the word "trees" had the value of 254. Consequently, it appears that if frequency is averaged over a concept, as was done in the present study, the average hides the difference in the passages.

Although attempts were made to equate passages by presenting them in a classification pattern, perhaps the construction of the passages was not totally parallel. This lack of parallelism may have resulted in unexpected passage differences which interfered with the frequency variable within passages.

An examination of the pre-test t-values summarized in Table 4.4 (A and B) indicates that experiential background may override the frequency variable. In the comparison of the animal passage (H.F.) versus the music passage (L.F.) there is a significant difference in the pre-tests within all treatments. This trend is consistent for all passages compared to the music passage and these significant differences are in favor of the music passage. This may be verified with reference to the means reported in Appendix D. Consequently,

prior to instruction it appears that students had more experiential background for the concept of music than they did for the other three concepts. Thus, even though music was designated a low frequency passage, experiential background had a definite effect. Therefore, it appears that frequency alone is not a good criterion for equating passages.

3. Differences in Treatments for Particular Time and Passage Combinations

An examination of the t-values for different treatments for particular time and passage combinations (Table 4.5) indicates that there are no statistically significant pre-test differences. The means and standard deviations are reported in Appendix D. Even though treatments and passages are confounded, there are no differences before treatments were given. Again, the variability within passages is evident. There were no statistically significant differences in treatments for the animal passage, yet there were generally statistically significant treatment differences for the plant passage. Many factors appear to be operating as has been discussed in the previous comparisons. Further discussion of these treatment differences will be presented with reference to specific hypothesis statements generated by the first general question.

The main effects have been presented for the first general question. Also, the significant interactions were discussed with reference to t-values computed by means of pairwise multiple comparisons. The main effects and the significant three-factor interactions indicate that some specific hypotheses generated cannot be addressed and, further, that others cannot be discussed in statistical terms.

Table 4.5

A Comparison of t-Values For Different Treatments
For Particular Time and Passage Combinations

Treatments	T	Passage			
		Animal	Plant	Music	Rock
CL vs. SM	Pre	0.858	-0.457	-0.343	-0.572
	Post	-1.660	-3.376*	-0.915	-0.686
CL vs. CM	Pre	0.686	0.400	1.030	0.484
	Post	-2.175	0.343	-2.002	2.060
CL vs. SD	Pre	0.973	0.057	1.888	-0.115
	Post	0.400	4.863*	3.662*	4.406*
SM vs. CM	Pre	-0.171	0.858	1.373	0.057
	Post	-0.515	3.720*	2.918*	2.746
SM vs. SD	Pre	0.115	0.056	2.231	0.457
	Post	2.060	8.240*	4.578*	5.092*
CM vs. SD	Pre	0.286	-0.343	0.858	0.400
	Post	2.575	4.520*	1.660	2.345
Tukey c.v. at $\alpha = .05$ for $df = 32,00 = 2.817$					

Therefore, those specific hypotheses generated by the first general question, which can be addressed, will be discussed with reference to the results of the probes into the interactions rather than treating them as null hypotheses to be accepted or rejected. Following this discussion, the main effects, interactions, and the specific hypothesis generated by general question two will be discussed.

Specific Hypothesis for General Question 1

Do different instructional methods result in different word association scores when assessed by number of target words (i.e. words which were the focus of instruction) and by number of total words (i.e. other words in addition to target words)?

Hypothesis 1.1 There are no significant differences in the mean target word association scores when considering the pre- and post-tests for treatment on science passages equated by overall frequency and organizational pattern.

The description of the data analysis for the main effects is reported in Table 4.1, page 81 and indicates that all main effects were significant along with significant two and three-way interactions (passage x treatment; treatment x time; passage x time; treatment x passage x time). Consequently, the interactions were probed in order to interpret the findings. The results of the probe into pre- to post-test gains for passage by treatment combinations indicate that three treatments (CL, SM, and CM) had a significant positive effect on most passages when assessed by target words gained from pre- to post-tests (Table 4.3, page 84). The findings of the probe into the differences within passages for treatment x time combinations indicate that there was little consistency in the significance within passages (Table 4.4, A and B, pages 86 and 87). The frequency

variable and experiential background may have contributed to this variability. A probe into differences for particular time x passage combinations indicated no statistically significant pre-test differences. Even though treatments and passages are confounded, there are no differences before treatments were given. Statistically significant differences in treatment appears to be passage dependent (Table 4.5, page 90).

Hypothesis 1.2 There are no significant differences in the mean target word association scores when considering post-tests on passages for CL, SM, and CM as compared to SD.

An examination of the t-values for mean differences in treatments for particular time x passage combinations (Table 4.6) indicates that there were no statistically significant pre-test differences before treatments were given. An examination of the post-test t-values indicates that the CL and SM treatments resulted in statistically significant differences (t-values reported respectively) in target word associations when compared to the SD treatment for the plant ($t = 4.863$; $t = 8.420$, $p < .05$), music ($t = 3.662$; $t = 4.578$, $p < .05$), and rock ($t = 4.406$; $t = 5.092$, $p < .05$) passages. The mean differences on the animal passage post-test, when comparing the CL and SM treatments with the SD treatment, resulted in statistically non-significant gains favoring the CL ($t = .400$, $p > .05$) and SM ($t = 2.060$, $p > .05$) treatments.

The CM treatment resulted in a statistically significant gain in more target words when compared to the SD treatment on the plant passage only ($t = 4.520$, $p < .05$). The CM and SD mean differences for the animal, music, and rock passages resulted in statistically non-significant gains favoring the CM treatment. The t-values by

Table 4.6

A Comparison of t-Values for CL, SM
and CM With SD Treatment for
Time and Passage Combinations

Treatment	Time	Animal	Plant	Music	Rock
CL vs SD	Pre	0.973	0.057	1.888	0.300
	Post	0.400	4.863*	3.662*	4.406*
SM vs SD	Pre	0.115	0.056	2.231	0.272
	Post	2.060	8.240	4.578*	5.092
CM vs SD	Pre	0.286	0.343	0.858	0.400
	Post	2.575	4.520*	1.660	2.345
Tukey c.v. at $\alpha = .05$ for $df = 32,00 = 2.817$					

type of passage are reported respectively ($t = 2.575$; $t = 1.660$; $t = 2.345$, $p > .05$). Statistically significant differences in treatment appears to be passage dependent.

Hypothesis 1.3 There are no significant differences in mean target word associations when considering post-tests on passages for the SM group as compared to the CL, CM and SD groups.

An examination of the t -values for mean differences in treatments for particular time x passage combinations (Table 4.7) indicates that there were no statistically significant pre-test differences. An examination of post-test t -values indicates that the SM treatment resulted in more target word associations which were statistically significant than; the CL in the plant passage ($t = 3.376$, $p < .05$); than the CM in the plant ($t = 3.720$, $p < .05$) and music ($t = 2.918$, $p < .05$) passages; and than the SD in the plant ($t = 8.240$, $p < .05$), music ($t = 4.578$, $p < .05$), and rock ($t = 5.092$, $p < .05$) passages. Since results are not consistent across all passages for the SM group when compared to the CL, CM and SD groups, it appears that gains may be attributed to differences among passages. All other mean differences, with one exception, indicate a statistically non-significant gain in favor of the SM treatment. The one exception was the CM treatment on the animal passage where a small, statistically non-significant gain, was in favor of the CM treatment ($t = .515$, $p > .05$).

Hypothesis 1.4 There are no significant differences in the mean target word association scores between pre- and post-tests on passages within treatment groups.

An examination of the post-test means and t -values from the pairwise multiple comparison (Table 4.3, page 84) indicates the CL treatment resulted in statistically significant target word gains between pre- and post-tests for the plant ($t = 6.343$, $p < .05$),

Table 4.7

A Comparison of t-Values for SM Treatment
with CL, CM and SD Treatments for Time
and Passage Combinations

TRT	Passage 1 B1 Animal Pre-Post	Passage 2 B2 Plant Pre-Post	Passage 3 B3 Music Pre-Post	Passage 4 Rock Pre-Post
SM vs CL Pre	- 8.58	.457	.343	.572
Post	1.660	3.376*	.915	.686
SM vs CM Pre	- .171	0.858	1.373	.057
Post	- .515	3.720*	2.918*	2.746
SM vs SD Pre	.115	.056	2.231	.457
Post	2.060	8.240*	4.578*	5.092*

* Tukey c.v. at $\alpha = .05$ for $df = 32,00 = 2.817$

music ($t = 3.792$, $p < .05$), and rock ($t = 7.032$, $p < .05$) passages but only a small statistically non-significant gain was made in the animal passage ($t = 1.723$, $p > .05$). The SM treatment resulted in statistically significant gains in target word associations between pre- and post-tests for all four passages; animal ($t = 4.756$, $p < .05$), plant ($t = 9.859$, $p < .05$), music ($t = 4.481$, $p < .05$), and rock. As well, the CM resulted in statistically significant gains for all four passages; animal ($t = 5.170$, $p < .05$), plant ($t = 6.411$, $p < .05$), music ($t = 2.620$, $p < .05$), and rock ($t = 3.929$, $p < .05$). The SD treatment resulted in statistically significant gains on the animal passage only ($t = 2.413$, $p < .05$). Gains were small and statistically non-significant. The findings indicate that three treatments (CL, SM, and CM) were effective.

Hypothesis 1.5 There are no significant differences in the mean target word association scores between groups when considering pre- and post-tests on all passages when degree of exposure to context was greater within treatments as compared to when degree of exposure to context was less within treatments.

The degree of exposure to context was hypothesized to vary in the treatments. Arranged from highest to lowest, they were: CL, SM, CM, and SD. All groups had exposure to the target words in context when the passages were first read to them. This was the only time the CM and SD group saw the target words within continuous text. However, the CM group did see the target words one more time within a correct classification format (see Appendix C). The SM group saw the target words a total of twice in context and the CL group saw them a total of four times within continuous text. As the CL treatment was considered to include the greatest degree of exposure to context and it did not result in statistically significant gains when compared to

the next context condition (SM), the context condition does not appear to be very effective.

An examination of the t-values for different treatments for particular time x passage combinations (Table 4.5, page 90) indicates that the CL treatment never resulted in more target words than the SM treatment. In fact, the trend indicated by the negative signs appears to be indicative of the reverse. That is, the SM treatment with less context provided, appears to result in more target word gain, although the mean difference is only statistically significant in the plant passage ($t = 3.376$, $p < .05$). A possible contributing factor may have been that the SM treatment group had a slight statistically non-significant advantage with the exception of the animal passage prior to treatment.

Another possibility is that the degree of exposure to context did not vary sufficiently to affect performance. Where the degree of exposure to context was the greatest (CL) and where degree of context exposure was the least (SD), the CL treatment resulted in statistically significant gains for the plant ($t = 4.863$, $p < .05$), music ($t = 3.662$, $p < .05$), and rock ($t = 4.406$, $p < .05$) passages.

The SM treatment group was exposed to more context than the CM treatment group and the SM treatment resulted in statistically significant gains in the plant ($t = 3.720$, $p < .05$) and music ($t = 2.918$, $p < .05$) passages. Also, gains approached significance on the rock passage ($t = 2.746$, $p > .05$). Again, where there was a greater variation in degree of exposure to context, as in the SM treatment compared to the SD treatment, the SM treatment results in statistically significant gains in the plant ($t = 8.240$, $p < .05$), music ($t = 4.518$, $p < .05$), and rock ($t = 5.092$, $p < .05$) passages.

The variation in exposure to context was very limited between the CM treatment and the SD treatment. However, the CM treatment resulted in statistically significant gains in the plant ($t = 4.520$, $p < .05$) passage when compared to the SD treatment.

Hypothesis 1.6 There are no significant differences in the mean total word association scores when considering the pre- to post-test for treatments on science passages equated by overall frequency and organizational pattern.

The analysis of variance for total word association scores (Table 4.2, page 82) and the description of the data analysis demonstrates that treatment was not a significant factor affecting the performance on the total word association tests. Due to these findings, this method of analysis was discontinued and, consequently, the specific hypotheses 1.6 - 1.10 will not be discussed.

General Question 2

Do instructional methods with two science passages containing words, on the average, which are more familiar to grade six students (high frequency passages) result in greater gains than methods with two science passages containing words which, on the average, are less familiar to grade six students (low frequency passages) when word association scores are assessed by number of target words and by number of total words?

The passage factor in this analysis contained two levels -- high frequency (plant plus animal) and low frequency (music plus rock) -- which were specified concepts within the grade six science subject area. The main effects for Question 2 will be discussed next.

Only assessment by number of target words was investigated as assessment by number of total words did not appear to be an appropriate

method of assessment when examining individual passages. That is, assessment by number of total word associations did not indicate that treatment was a factor affecting performance on the word association test. To answer this question, the scores for total number of word associations were tallied and submitted to an analysis of variance. The results for the target word analysis on high and low frequency passages are presented in Table 4.8. The means and standard deviations are reported in Appendix D.

The analysis of variance for target words showed that treatment, passage, and time (from pre- to post-tests) were significant factors affecting the target word association test [for treatment, $F(3,56) = 7.40, p < .05$; for passage, $F(1,56) = 21.11, p < .05$; and for time, $F(3,168) = 6.46, p < .05$]. But, the following two-way interactions were also significant. Treatment and time were significant factors between subjects within groups, resulting in a treatment x time interaction [$F(9,168) = 6.46, p < .05$]. Passage and time were significant factors between subjects within groups, resulting in a passage x time interaction [$F(3,168) = 95.54, p < .05$]. In addition, the following three-way interaction was found: the treatment x passage x time interaction was significant between subjects within groups [$F(9,168) = 4.57, p < .05$].

Following the analysis of variance on high and low frequency passages, one set of complex comparisons were computed to investigate the treatment x passage x time interaction. The complex comparison assessed the mean differences within high and low frequency passages for a particular treatment by time combination.

Table 4.8

Analysis Of Variance Performance
on Target Word Association For
Treatment, High and Low Frequency
Passages, and Test Time

Source of Variance	Sum of Squares	df	Mean Square	F ratio	Level of Significance
Treatment (A)	725.783	3	241.927	7.40	0.000 *
Error Term	1830.583	56	32.688		
Passage (B)	192.533	1	192.533	21.11	0.000 *
AxB	38.716	3	12.905	1.41	0.248
Error Term	510.750	56	9.120		
Time (C)	3336.966	3	1112.322	125.05	0.000 *
AxC	517.183	9	57.464	6.46	0.000 *
Error Term	1494.350	168	8.894		
BxC	1241.233	3	413.744	95.54	0.000 *
AxBxC	178.250	9	19.805	4.57	0.000 *
Error Term	727.516	168	4.330		
* $p < .05$					

The rate of Type I error was controlled at $\alpha .05$ by using the Scheffé criterion of significance. The probe into the interaction will be discussed next, followed by a discussion of specific hypothesis 2.1, generated by the second general question.

Differences in High and Low Frequency Passages for Particular Time and Treatment Combinations

The t-values for the high frequency (H.F.) versus the low frequency (L.F.) passages are reported in Table 4.9. These results were anticipated as a result of the probe into individual passage differences (Tables 4.4, A and B, pages 86 and 87). An examination of the t-values almost consistently demonstrates the L.F. passages resulted in more target word gain than H.F. passages. However, as was previously discussed, this was likely due to the role of personal experience rather than the frequency factor. It appears that H.F. and L.F. passages, as they were presented in this study, are not a statistically significant factor affecting target word gain.

Specific Hypothesis for General Question 2

Do instructional methods with two science passages containing words, on the average, which are more familiar to grade six students (high frequency passages) result in greater gains than methods with two science passages containing words which are, on the average, less familiar to grade six students (low frequency passages) when word association scores are assessed by number of target words and by number of total words?

Hypothesis 2.1 There are no significant differences in the mean target word association scores when considering pre- and post-tests for treatments with high frequency passages as compared to treatment with low frequency passages.

Table 4.9

A Comparison of t-Values for High
Frequency Versus Low Frequency
Passages for Pre-and Post-Test
Within Four Treatments

	CL	SM	CM	SD
Pre (H.F. vs. L.F.)	-2.315	-3.582*	-2.866	-1.599
Post (H.F. vs. L.F.)	-4.520*	-1.212	+1.157	-1.817
Scheffé				
c.v. at $\alpha = .05$, for df 9,314 = 3.059				

The analysis of variance for target word association scores for high and low frequency passages, treatment, and time (Table 4.3, page 84) and the description of the data analysis reported previously, indicates that the treatment was a significant factor but that the treatment x passages interaction was not significant. There was, however, a treatment x passage x time interaction. This interaction was investigated and the results are reported in Table 4.8, page 100.

An examination of the t-values for H.F. versus L.F. passages (Table 4.8, page 100) indicates the L.F. passages resulted in more target word gain than H.F. passages across treatments with the exception of the CM treatment. This trend is indicated by the negative values, thus suggesting that the L.F. passages were easier. However, only within the CL treatment post-test, did the target word gain for L.F. passages reach statistical significance ($t = 4.520$, $p < .05$). Again, there is an indication of the role of personal experience overriding the frequency variable as was discussed in the comparison of passage differences (Table 4.6, page 93) under the heading of interactions. The role of personal experience may be responsible for the statistically significant difference within the SM treatment at the pre-test time ($t = 3.582$, $p < .05$) in favor of the low frequency passage. As all other t-values were relatively low, it appears that the frequency variable did not operate as predicted nor was it effective.

The specific hypothesis 2.2 will not be discussed as assessment by number of total words did not appear to be an appropriate method of assessment. A qualitative analysis of the third general question follows.

Qualitative Analysis

General Question 3

What are some qualitative differences among students' performance on word scores when examined for differences within treatment groups as measured by: the Durrell, total pre-test target words, total task scores and total post-test association scores, and the relationship of Durrell scores and total target word post-test scores?

Question 3.1 Are there differences in treatment groups as measured by the Durrell pre-test?

As treatment groups were matched according to the listening vocabulary subtest scores of the Durrell Listening-Reading Series, with all groups having equal means, no statistically significant differences were anticipated. However, t-tests were computed for the purpose of providing the standard deviations within and between groups (Table 4.10). All t-values were statistically non-significant.

Question 3.2 Are there differences in treatment groups as measured by total pre-test target words?

Total pre-test target words refers to all pre-tests for all passages pooled within treatment groups. An examination of the t-values comparing total pre-test target word (pooled across passages) between treatment groups (Table 4.11) indicates no significant differences between the following treatment groups: CL vs SM ($t = 0.34$, $p > .05$), CL vs CM ($t = 1.12$, $p > .05$), CL vs SD ($t = 1.90$, $p > .05$), SM vs CM ($t = 1.54$, $p > .05$), and CM vs SD ($t = 0.89$, $p > .05$). However, there is a statistically significant mean difference on total pre-test target words between the SM treatment group and the SD treatment group ($t = 2.34$, $p < .05$). As was previously pointed out, in a

Table 4.10

A Comparison of Durrell Scores For
Treatment Groups

Group	Number	Standard Deviation	Mean Durrell Score	t
CL	15	12.575	66.000	0.0
SM	15	8.644	66.000	
CL	15	12.575	66.000	0.0
CM	15	8.133	66.000	
CL	15	12.575	66.000	0.0
SD	15	10.630	66.000	
SM	15	8.644	66.000	0.0
CM	15	8.133	66.000	
SM	15	8.644	66.000	0.0
SD	15	10.630	66.000	
CM	15	8.133	66.000	0.0
SD	15	10.630	66.000	

$t(28) = 2.048, p = \alpha.05$

*significant beyond the 0.05 level.

comparison of high frequency and low frequency passages (Table 4.8, page 100), the SM treatment group appeared to have significantly more experiential background in low frequency passages. The t -value was significant at the pre-test time ($t = -3.582$, $p < .05$). Also, in a comparison of means for differences in individual passages (Table 4.6, page 93), the music passage (L.F.) appeared to be a more familiar concept to all treatment groups. However, the t -values varied considerably between the SM group and the SD group. For example, on the animal vs. rock passage, the SM treatment group's t -value was much higher than that of the SD treatment group (SM; $t = 7.103$, $p < .05$ and SD; $t = 4.215$, $p < .05$). The differences were similar for other comparisons with the music passage. Thus, it appears that the SD treatment group have not been exposed to, or have not developed the same interest in the concept of music.

Question 3.3 Are there differences on total task scores (scores on training tasks) and total post-test association scores within three treatment groups (CL, SM, CM)?

The number of total word associations did not appear to be an effective method of assessment for treatment in the present study. Therefore, an investigation into the relationship between total word association scores and scores on training tasks was pursued. Means (pooled across passages) on training tasks for three treatment groups (CL, SM, CM) and the means for post-test total word associations are reported in Table 4.12. The means for both sets of scores were given a rank value.

An examination of Table 4.12 indicates a mean difference on training tasks but very little variability among the means for post-test total word associations for the three treatment groups. It

Table 4.11

A Comparison of Total Pre-test Target
Word (Pooled across passages) For Four Treatment Groups

Group	Number	Standard Deviation	Mean Pooled Pre-test Target Word Scores	t
CL	15	4.941	15.466	0.34
SM	15	4.590	16.066	
CL	15	4.941	15.466	1.12
CM	15	4.188	13.600	
CL	15	4.941	15.466	1.90
SD	15	4.443	12.200	
SM	15	4.590	16.066	1.54
CM	15	4.188	13.600	
SM	15	4.590	16.066	2.34*
SD	15	4.443	12.200	
CM	15	4.188	13.600	0.89
SD	15	4.443	12.200	

t (28) = 2.048, p = α .05
*significant beyond the 0.05 level.

appears that the post-test total word association scores are not a sensitive measure of performance on training tasks. This finding is consistent with the results of the analysis of variance performance on total word association for treatment, passage, and test time, which showed that treatment was not a significant factor affecting performance on the word association test (Table 4.2, page 82). As was found in the pilot study, total word associations tended to include experiential vocabulary which obscured the difference in target words gained as a result of treatment.

Question 3.4 What are the relationships between subjects' scores on the Durrell and subjects' scores on total target word post-test?

The Durrell Listening Vocabulary test was selected as a grouping measure in this study, because it requires classification procedures similar to the ones used in the treatments. The target word association test was selected as a dependent measure as it, too, appeared to be closely aligned with the instructional methods used. Thus, an investigation into the relationship between Durrell scores on four passages was pursued. The Pearson product-moment correlation was employed to investigate this relationship.

An examination of the correlation matrix (Table 4.13) indicates a statistically significant relationship between the two measures on all four passages. The multiple correlation was also statistically significant ($R = 0.486$, $p < .05$). It appears that both measures were appropriate for the purpose of this study.

Summary

The specific statistical procedures which were used in analyzing the data for testing the various hypotheses and a general discussion of these hypotheses have been presented earlier in this chapter. The procedures which were used to analyze qualitative differences among students' performance on word scores have also been described.

General Findings

The overall analysis of variance (Tables 4.1, 4.2 and 4.8) revealed different results depending on the level of the dependent variable and the level of the passages employed in the analysis. The analysis of variance for target words (Table 4.1, page 81) showed that treatment, passage, and time (from pre- to post-tests) were significant factors affecting the target word association test. However, there was also a significant treatment x passage x time interaction. The analysis of variance for total word association revealed that treatment was not a significant factor affecting performance on the word association test (Table 4.2, page 82). The results for the target word analysis, with high and low frequency passages, revealed that treatment, passages and time (from pre- to post-tests) were significant factors affecting the word association test. Although there was a significant treatment x passage x time interaction, the treatment x passage interaction was non-significant (Table 4.8, page 100). Consequently, only analyses of variance for target word associations were probed. Post hoc comparisons among the cell means, using the Tukey and Scheffé procedures, indicated some significant trends.

Table 4.12

Means On Training Tasks and Post-Test Total Word Associations For Three Treatment Groups.

Treatment	Training Task		Post-Test	
	Mean	Rank	Mean	Total Word Rank
CL	83.13	1	66.2	3
SM	74.2	3	68.6	1
CM	79.4	2	67.13	2

Table 4.13

Correlation Matrix For Durrell Scores and Post-Test Target Word Association Scores on Four Passages.

Variable	Correlation Matrix				
	1	2	3	4	5
1. Durrell	—				
2. Animal	0.25 *	—			
3. Plant	0.27 *	0.54 *	—		
4. Music	0.45 *	0.53 *	0.64 *	—	
5. Rock	0.44 *	0.43 *	0.65 *	0.74*	—

* c.v. at $\alpha = .05$ for $df = 58 = 0.250$

Comparison Among Cell Means

The first set of multiple comparisons indicated a statistically significant trend in the mean gains from pre- to post-tests for passages for three treatments: CL, SM and CM. The results for the SD treatment did not reveal a significant trend (Table 4.3, page 84). Since the SD treatment was a planned benchmark treatment, a significant gain from pre- to post-test was not anticipated. There was also an indication from these comparisons that a significant difference existed between the music passage and the others. The trend indicated that the treatment groups had the most experiential background in the music passage (a condition which may have confounded the frequency variable) and the least experiential background in the rock passage. Graphs which represent the mean gains (rounded off to the nearest decimal) from pre- to post-test on four passages for four treatment groups, are included in Appendix E.

The second set of multiple comparisons indicated a statistically significant trend in the mean differences between the music passage and the others for all four treatments at the pre-test time. Tables 4.4 (A and B, pages 86 and 87) report the t-values and graphs are included in Appendix E. It appeared that the treatment groups had a superior experiential knowledge of this concept even though the averaged frequency values had designated it a low frequency passage. The animal passage (H.F.) also appeared to differ in some way, as it interacted with both the plant passage (H.F.) and the rock passage (L.F.) within three treatment groups (CL, SM, CM). Perhaps the number of target words played a role, for in the animal passage there were 42, in the plant passage 32, and in the rock passage 22. The

frequency variable, as employed in this study, does not appear to be effective in the way that it was measured.

A third set of multiple comparisons of mean differences in treatments for particular passage and time combinations revealed no statistically significant differences in treatments for the animal passage. A statistically significant trend was indicated between the SM treatment and the CL treatment, when compared to the SD treatment on three passages (plant, music, and rock), at post-test time. The SM treatment, when compared to the CM treatment, was statistically significant on two passages (plant and music) at post-test time. The overall trend indicated there were no significant differences among the CL, SM, or the CM treatments, but there was a significant difference between the CL and SM treatments when compared to the SD (benchmark) treatment (Table 4.5, page 90). Graphs are included in Appendix E.

The complex multiple comparisons for differences in high frequency passages, when compared to low frequency passages within treatments at test times, revealed no statistically significant trend (Table 4.9, page 102). However, within three treatments (CL, SM and SD) performance on the low frequency passages was superior to performance on high frequency passages in both pre- and post-test times. Graphs are included in Appendix E.

The qualitative analysis verified that groups were matched equally according to the listening vocabulary subtest of the Durrell Listening-Reading Series. An analysis of the pre-test target words (pooled across passages) revealed equality between groups prior to instruction, with one exception. There was a statistically

significant mean difference on total pre-test target words between the SM and SD treatment groups.

Although there was a mean difference on training task scores in three treatment groups (CL, SM and CM) there did not appear to be a relationship between these means and the means of the total word association scores. Analysis by total word association scores did not appear to be a sensitive measure for assessing vocabulary gained.

A correlational analysis indicated a statistically significant relationship between Durrell scores and post-test target word scores for four passages. The multiple correlation was also statistically significant. Therefore, it appeared that the Durrell pre-test used for matching groups and the target word association test used for assessing vocabulary gained were sensitive to the treatments employed in this study.

Relationship to Other Findings

Previous research findings regarding the effects of the cloze procedure for developing vocabulary in the content area of science have remained limited and inconclusive. Johns (1977) found that vocabulary development approached significance after eleven weeks of cloze instruction, using mainly science material. Sinatra (1977) found cloze instruction effective for developing vocabulary within four content areas, one of which was science. Vocabulary gains from pre- to post-test were statistically significant. The present study adds to the above findings in that it found cloze instruction effective for developing science vocabulary presented within passages written in a classification pattern. Vocabulary gains from pre- to post-testing times were statistically significant for three out of four passages.

Research findings regarding the effectiveness of semantic mapping and category matching, as methods for developing vocabulary, were not located in the literature. The present study has provided some insights into the effectiveness of these methods for developing science vocabulary presented in passages written in a classification pattern. This study found that the semantic mapping and the category matching instructional methods resulted in statistically significant vocabulary gains from pre- to post-tests for four science passages.

Jenkins and Pany (1977) have suggested that relatively few studies directly document the relative effectiveness of specific vocabulary instructional methods. The present study has provided insights into the relative effectiveness of four vocabulary instructional methods. Although the cloze, semantic mapping, and category matching methods of instruction were effective in developing science vocabulary, there were no significant differences among these methods. However, the cloze and semantic mapping methods were significantly more effective than the story discussion method.

Past research (Petty, Herold, and Stoll, 1968) has demonstrated that strategies for vocabulary development which focus on systematic instruction are superior to those which attempt to develop vocabulary by means of incidental instruction. The present study adds to these findings in that the story discussion treatment was generally less effective in developing vocabulary when compared to the other three methods.

Wittrock et. al. (1975) found that high frequency passages markedly facilitated vocabulary development. The present study found

that the frequency variable was confounded by what appeared to be experiential background variables. However, the method of designating passages as high or low frequency may have been inadequate.

Froese (1977) found more variability in response to low associative sentences than to high associative sentences. The present study did not control the word association factor within passages. Although all passages were written in a classification pattern, the associative factor may have contributed to differences within passages which, in turn, interacted with treatments.

In this chapter, the three general questions posed at the beginning of the study have been evaluated and discussed in detail. The specific hypotheses or questions which were generated by these general questions were responded to on the basis of the results of the data analysis. The conclusions based on these findings, applications to educational practice, and suggestions for further research are presented in Chapter 5.

Chapter 5

SUMMARY AND CONCLUSIONS

The major purpose of this study was to investigate the differential effects of four instructional methods of developing sixth-grade science vocabulary. The four methods were identified as the cloze method (CL), semantic mapping (SM), category matching (CM), and story discussion (SD).

The data was analyzed by applying three-way analyses of variance using the factors treatment, passages, and test time with repeated measures on two levels of one dependent variable, the word association test (target words and total words). The .05 level of significance was selected for the acceptance or rejection of all statistical tests. There were significant treatment, passage, and time effects, as well as two and three-way interactions as a result of the assessment by target words. In order to interpret more precisely the interactions, post hoc comparisons among the cell means were carried out using Tukey and Scheffé procedures. There were no significant treatment effects as a result of the assessment by total words and, consequently, this method of analysis was not pursued.

Since the number of research studies which test the cloze, semantic mapping and category matching instructional methods for the purpose of developing vocabulary seemed limited, it appeared that a study might provide further insight into our knowledge of how vocabulary might be taught. It has been suggested that determining the

relative effectiveness of different instructional strategies has important implications for the nature of vocabulary instruction (Jenkins and Pany, 1977). Consequently, the present study was undertaken.

The aim of each instructional method was to assist students in developing vocabulary related to specific science concepts. The subjects in the CL group were taught how to use context clues, structure of text, and beginning consonant clues, to arrive at the appropriate response for cloze deletions. The subjects in the SM treatment group were taught how to brainstorm from recall, target words in text, and how to classify target word responses into a hierarchical schematized structure. The CM subjects were instructed to unscramble words with use of a thesaurus or dictionary, if desired, and to place them under appropriate labels provided for them. The SD treatment group discussed ten general questions with the instructor and were then required to draw a picture about the passage contents. A more detailed description of the methods is found in Chapter 3. In this study, answers were sought for three general questions:

1. Do different instructional methods result in different word association scores when assessed by number of target words (i.e. words which were the focus of instruction) and by number of total words (i.e. other words in addition to target words)?

2. Do instructional methods with two science passages containing words which, on the average, are more familiar to grade six students (high frequency passages) result in greater gains than methods with two science passages containing words which, on the average, are

less familiar to grade six students (low frequency passages) when word association scores are assessed by number of target words and by number of total words?

3. What are some qualitative differences within treatment groups as measured by: the Durrell, total pre-test target words, total task scores and total post-test association scores, and the relationship between Durrell scores and total target word post-test scores?

Summary of the Design

The subjects in the study were 60 sixth-grade students selected from within four classrooms (two classes in each of two schools) within one Western School Division in rural Manitoba. Four groups of subjects were formed by matching procedures using Durrell listening vocabulary scores. This test appeared to be a measure which would be sensitive to the treatments undertaken. Each intact group was randomly assigned to one of the treatment groups. Each of the four treatment groups contained 15 students. Students were selected so the total raw scores on the Durrell for each group equalled 990 and the average was 66 (see Table 4.11, page 107 and Appendix A for details). The raw scores ranged from 36 to 86, thus, the subjects were representative of a range of ability levels. The median score for each group was 67, 68, 69 and 67.

The instructional materials consisted of three passages written in a classification pattern which were selected from supplementary science material and one passage which was developed for this project because no suitable passage could be located. The concepts (animal, plant, music, and rock) were selected from those taught in the regular

grade six science program. Selected nouns which represented super-ordinate categories and subordinate terms became target words for the study and were underlined in the passages which the students read. The various passages dealt with animals, plants, music, and rocks, and the number of target words within these passages was 46, 32, 32 and 22, respectively.

The frequency values for the target words were obtained by grade and by content area (science) from The American Heritage Word Frequency Book (Carroll et. al., 1971). The frequency values for target words were tabulated, totalled, and averaged for each passage both for frequency of usage at the grade six level and for frequency of usage in the field of science. The frequency values for each passage are included in Appendix C. The animal and plant passages were designated as high frequency passages and the music and rock passages were designated low frequency passages.

The dependent measure was a two minute timed word association test, assessed at two levels; target words (i.e. words which were the focus of instruction), and total words (i.e. other words in conjunction with target words). The word association test was administered at pre- and post-test times. Pre-tests for high frequency passages (animal and plant) were administered one day prior to four instructional lessons (four 30 minute periods, twice per week), and the day following instruction, a timed post-word association test was administered for the same two passages. The same procedure was followed before and after the instruction on the low frequency passages (music and rock) (see Figure 3.1, page 60).

Summary of Findings and Conclusions

The findings and conclusions are summarized as follows:

1. Three way analyses of variance using the factors treatment (four levels), the passages (four levels) and test time (two levels), were computed for number of target words (i.e. words which were the focus of instruction) and number of total words (i.e. other words, in conjunction with target words). All main effects were significant, as well as significant two and three-way interactions (passage x treatment; treatment x time; passage x time; treatment x passage x time) (Table 4.1, page 81). Consequently, comparisons among the cell means were carried out in order to more precisely interpret the meaning of the interactions.

There were no significant treatment effects as a result of the assessment by total words (i.e. other words in addition to target words) and, consequently, this method of analysis was not pursued (Table 4.2, page 82). This resulted in dropping from the study, any further analysis of a number of specific hypotheses (e.g. 1.6 - 1.10 and hypothesis 2.2).

2. A third analysis of variance using the factors treatment (four levels), passages (two levels), and test-time (two levels) were computed for number of target words. Again, there were significant treatment by passage by time interactions (Table 4.8, page 100). Consequently, further trend analysis were necessary to probe these interactions because it was not clear which factors, at which levels, were contributing to target words gained.

3. There were significant treatment by passage by time interactions on the analysis of variance for target words using four

levels of treatment factors and four levels of passage factors. Multiple pairwise t-tests (with the Tukey criterion of significance) were used to probe these interactions. Three sets of multiple pairwise comparisons were computed. The first set of multiple comparisons assessed the mean gains from pre- to post-test for each passage within each treatment. The second set assessed the mean differences within passages for particular treatment by time combinations and the third set assessed the differences within treatments for particular treatment by time combinations. The findings indicated that treatment effectiveness was passage dependent.

4. The mean gains from pre- to post-test for each passage within each treatment were assessed. The results are reported in Table 4.3, page 84. The multiple t-tests indicated statistically significant pre- to post-test gains for the CL treatment on three passages (plant, music, and rock). There were significant differences between pre- and post-tests for the SM and CM treatment groups on all four passages (animal, plant, rock, and music). The SD treatment was based on incidental instruction, significant gains were not expected.

5. Multiple t-tests were computed to assess mean differences within passages for particular treatments by time combinations. The t-values are reported in Table 4.4 A (page 86) and Table 4.4 B (page 87). There were statistically significant mean differences between the music passage and the others (animal, plant, and rock) within the four treatments at pre-test time. The significant differences in the music passage when compared to the others, were attributed to a superior experiential knowledge of this concept within the treatment

groups prior to instruction. There were also significant differences between scores on the animal passage and the plant and rock passages. However, these differences were not consistent within all treatments and could not be considered a trend.

As there were significant differences between the animal and plant passages (both designated high frequency passages) and between the music and rock passages (both designated low frequency passages), it was concluded that the frequency variable, as employed in this study, was not effective.

6. The mean differences within treatments were assessed for particular time by passage combinations. The t-values are reported in Table 4.5, page 90. There were no statistically significant pre-test differences. Thus, it was concluded that, even though treatments and passages were confounded, there were no differences in groups before treatments were given. There were no significant differences in treatments for the animal passage. There were significant differences between the SM and the CL treatment groups, when compared to the SD treatment group, on three passages (plant, music, and rock) at post-test time. The SM treatment, when compared to the CM treatment, was significantly different on two passages (plant and music) at the post-test time. It was concluded that the overall trend indicated there was no significant treatment differences among the CL, SM and CM treatments, but there was significant difference between the CL and SM treatments when compared to the SD (benchmark) treatment.

7. There were significant treatment by passage by time interactions when the passage factor consisted of two levels (high frequency and low frequency). Complex multiple t-tests (using the

Scheffé criterion of significance) were computed to probe these interactions (Table 4.9, page 102). There were significant differences within the CL treatment group at post-test time, in favor of the low frequency passages. However, there were significant differences within the SM treatment group at pre-test time, in favor of the low frequency passages. It was concluded there were no statistically significant trends. However, within three treatments (CL, SM, and SD), performance on the low frequency passages was superior to performance on the high frequency passages at both pre- and post-test times. These results were expected following the pairwise multiple comparison for differences in individual passages for particular treatment by time combinations. It was again concluded that the frequency variable, as employed in this study, was not effective. Secondly, it was concluded that interest and experience may well override the frequency variable.

8. No statistically significant differences were found among the treatment groups, as measured by the Durrell Listening-Reading Series listening vocabulary subtest. Since the groups were formed using matching techniques based on pre-test scores, these results were to be expected. Results are reported in Table 4.10, page 105 and Appendix C.

9. An analysis of the pre-test target words (pooled across passages) revealed no significant differences between groups (with one exception) prior to instruction. There was a significant difference on total pre-test target words between the SM and SD treatment groups (Table 4.11, page 107). Consequently, even though treatments and passages were confounded, the treatment groups were equal prior to instruction with one exception.

10. There were mean differences on training task scores in three treatment groups (CL, SM and CM). The CL treatment ranked first, then CM, followed by SM. The means for post-test total word associations did not differ by more than two points. Means and ranks are reported in Table 4.12, page 110. Consequently, it was concluded that there was no relationship between scores on training tasks and scores on total word associations. These results were consistent with those found on the analysis of variance for total word associations. Treatment was not a significant factor affecting performance on the word association test. It was concluded that the total word association measure tended to include experiential vocabulary which obscured the differences in target words gained as a result of the experimental treatments.

11. The Pearson product-moment correlation procedure was employed to investigate the relationship between Durrell pre-test scores (used for matching groups) and the post-test target word scores (the dependent measure). These correlations may be found in Table 4.13, page 110. There were significant correlations between the two measures on all four passages with a significant multiple correlation. The post-test target words for the four passages (animal, plant, music, and rock) were combined and correlated with the Durrell pre-test scores resulting in a positive correlation ($R = 0.486$, $p < .05$). It was concluded that both measures assessed similar effects and, hence, they were appropriate measures for the purpose of this study.

Discussion

The findings of the present study must be interpreted in terms of previous theory and research which was discussed in Chapter 2.

Studies such as those of Johns (1977) and Sinatra (1977) have demonstrated the potential of the cloze technique as an instructional method for developing science vocabulary. Jongsma (1980) had speculatively concluded that, although cloze instruction does not seem to be effective in improving vocabulary, it does appear useful in helping students learn to read and understand content material. He further commented that perhaps the criterion measure for assessing vocabulary growth was not sensitive to the cloze instructional method.

The present study added to the above findings in that it found cloze instruction effective for developing science vocabulary presented within passages written in a classification pattern. Vocabulary gains from pre- to post-test assessed by a target word association test, were statistically significant for three out of four science passages.

Research findings regarding the effectiveness of semantic mapping and category matching, as methods for developing vocabulary, were not located in the literature.

The findings of the present study have provided some practical insights as to the effectiveness of these methods for developing science vocabulary presented in passages written in a classification pattern. This study found that both the semantic mapping and category matching instructional methods resulted in statistically significant vocabulary

gains from pre- to post-tests, when assessed by a target word association test for the four science passages used to present the vocabulary.

Petty, Herold, and Stoll (1968) have demonstrated that strategies for vocabulary development which focuses on systematic instruction, are superior to those which attempt to develop vocabulary by means of incidental instruction.

The finding that the story discussion treatment in this study was generally less effective in developing vocabulary when compared to the other three methods adds support to the above findings. Although it should be noted that the story discussion treatment did result in statistically significant vocabulary gains from pre- to post-test on one of the four passages. Vocabulary gains were made on the first passage used for instruction and, consequently, the novelty of a different instructor may have been responsible for the gains.

Jenkins and Pany (1977) have suggested that few studies have directly documented the relative effectiveness of different teaching methods for developing vocabulary.

The present study has provided insights as to the relative effectiveness of four vocabulary instructional methods. The cloze, semantic mapping, and category matching methods of instruction were effective in developing science vocabulary. The semantic mapping method was significantly different from the other treatments only on some passages. Two vocabulary instructional methods (cloze and semantic mapping) were significantly more effective than the story discussion method on all four passages.

Wittrock et. al. (1975) found that students who first received passages with high frequency vocabulary, then received the

same passages with low frequency vocabulary, had markedly improved vocabulary scores. Anderson and Freebody (1981) suggested that there is some confusion about the word frequency manipulations which, perhaps, detracts from the findings.

The present study attempted to designate passages high and low frequency by averaging the frequency values of the target words within passages. It appeared that this method of designating high and low frequency was inadequate. The frequency variable alone was not a good criterion for equating two high and two low frequency passages. The frequency variable was also confounded by what appeared to be interest and experiential background variables. The variation in the number of target words presented within each passage (42, 32, 32 and 22) may also have interfered with the word frequency variable. Consequently, differences in treatments may have been obscured as a result of differences within passages.

Samuels (1968) found that recall was significantly better on passages embedded with high associative words. Froese (1977) found that the associativity factor between high and low association sentences was highly significant. He also suggested that, in educational practice, the development of word meanings might be facilitated by encouraging students to freely associate words in response to a stimulus word and to classify them according to Lindsay and Norman's (1972) semantic networks.

The present study did not attempt to control the word association factor within passages. Although all passages were written in a classification pattern (the words were closely related) the associative strength of the words within one passage may have been quite different

from those in another. Consequently, the associative factor may have contributed to differences between passages which, in turn, interacted with treatment effects.

It appears that Froese's (1977) recommendation for the development of word meanings through the use of Lindsay and Norman's (1972) semantic networks is a useful one. The present study found the semantic networks (semantic maps) an effective tool for developing vocabulary presented in four science passages.

Gipe (1977) had suggested that research in vocabulary development has not dealt with the theoretical bases for the methods used.

This study attempted to provide the theoretical bases used for each method. However, as there were few significant differences between treatments, the study did not provide many insights into the theories underlying vocabulary development.

Limitations of the Study

The following limitations need to be recognized when considering the findings of this study. The limitations presented in Chapter 1 have been restated and further limitations, as recognized by the investigator, have been reported.

1. The investigator was limited to analyzing data for sixth-grade students in two schools, in one rural school division, and generalizations beyond this setting should not be made.

2. The investigation was limited to four methods of teaching science vocabulary related to four specified concepts written in a classification pattern and cannot be generalized to other teaching methods, vocabulary or writing patterns.

3. Due to time constraints the study consisted of only eight lessons per group over a four-week period.

4. Measurement of the students' performance was limited to the accuracy and validity of the timed word association tests used as measuring devices.

5. The unequivalence of the passages must be considered. Two passages were initially equated according to the average low frequency values of the target words and two passages were equated on the average high frequency values of the target words. This method of designating passages low or high frequency, may not be appropriate. Secondly, the number of target words presented within each passage was not equal. Traditional readability, however, was the same for all the passages.

6. Exact repetition of the instructional methods may be impossible to replicate because of the open-ended nature of the instructional procedures and, therefore, comparisons of the findings must be viewed with caution.

Implications for Educational Practice

A number of results from this study have implications for educational practice.

1. Teachers of science content should have knowledge concerning the instructional procedures used in the cloze technique for the purpose of developing vocabulary.

2. Teachers of science content should have knowledge concerning the construction of the semantic mapping material and knowledge concerning the procedures used in semantic mapping instruction for the purpose of developing vocabulary.

3. Three instructional methods: cloze, semantic mapping, and category matching are of benefit to grade six students for developing science vocabulary which is presented within the text structure of a classification pattern.

4. There is a need to make teachers cognizant of the fact that one method of vocabulary instruction may be more effective than another for some passages and for some students. From the results of this study it appeared that interest and experiential background with a particular concept had an overriding effect on the frequency variable.

Implications for Future Research and Development

This study has provided additional information regarding the differential effects of four methods of developing sixth-grade science vocabulary. The four methods were identified as cloze, semantic mapping, category matching, and story discussion. However, it has also raised issues which require further investigation. Some of these are:

1. There is a need to operationally define and outline the instructional procedures and material that constitute the semantic mapping teaching strategy.

2. The results of the present study suggest that three methods (cloze, semantic mapping, and category matching) are effective in improving sixth-grade science vocabulary presented in a classification pattern. Further empirical studies are needed.

3. There is a need to investigate the feasibility of training classroom teachers in semantic mapping so that they are able to develop

instructional materials for their students since it is one of the most effective methods.

4. There is need to investigate the four instructional methods (cloze, semantic mapping, category matching, and story discussion) for the purpose of developing vocabulary when the target words are presented within the context of different writing patterns (e.g. comparison or contrast, sequence, Robinson, 1975).

5. Results of the present study suggest that the associativity strength (high or low) of the target words may have resulted in passage difference. Further investigations should consider the word association variable with reference to the Word Associations Norms: Grade School Through College (Palermo and Jenkins, 1964).

6. Further comparisons of the four instructional methods used in this study for developing vocabulary within the context of different passages need to equate the number of target words within each passage.

7. The results of the present study indicate that interest and experiential background may override such variables as frequency and writing patterns. There is a need to investigate feasible methods of measuring these variables.

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APPENDIX A

RAW SCORES FOR MATCHED GROUPS
AND WORD ASSOCIATION TEST
BLANK (SAMPLE)

Durrell Listening-Reading Series
 Listening Vocabulary Raw Scores
For the Four Treatment Groups

	Treatment			
Subject	CL	SM	CM	SD
1	86	79	79	80
2	84	77	76	78
3	77	77	75	77
4	74	73	74	76
5	72	69	70	74
6	72	68	69	68
median7	67	68	69	67
8	64	68	67	65
9	64	66	63	63
10	63	62	63	63
11	63	61	60	62
12	57	60	59	62
13	57	58	59	60
14	54	56	56	57
15	36	48	51	38
Total 990	990	990	990	990
Mean	66.000	66.000	66.000	66.000
Standard D.	12.575	8.644	8.133	10.630

Word Association Pre- and Post-Test Blank Example

Name: _____
Date: _____

ANIMAL KINGDOM

[illegible]

APPENDIX B

TARGET WORD
FREQUENCY VALUES

Low Frequency Concept: by Grade and by Content Area

ROCKS & MINERALS

<u>Words</u>	<u>Gr. 6</u>	<u>Sc.</u>
anthracite Coal	1	1
basalt	7	9
bituminous coal	0	2
conglomerate	0	2
feldspar	0	9
gneiss	2	0
granite	12	19
hornblende	1	6
igneous	6	35
limestone	10	22
marble	15	12
metamorphic	1	5
mica	7	3
obsidian	0	4
pumice	1	8
quartzite	3	1
quartz	3	29
sandstone	10	21
schist	7	0
sedimentary	2	35
shale	6	5
slate	9	0
Total	103	228
Average	4.68	10.36

Low Frequency Concept: by Grade and by Content Area

MUSICAL INSTRUMENTS

<u>Words</u>	<u>Gr. 6</u>	<u>Sc.</u>
banjo	7	0
bass	23	7
bassoon	1	0
bells	44	1
brass	1	0
bugle	15	0
castanets	2	0
cello	5	0
clarinet	3	0
cornet	0	0
cymbals	5	0
drum	29	11
English horn	—	—
flute	10	0
guitar	17	3
harp	15	1
horn	21	7
kettledrums	1	0
oboe	4	0
percussion	0	0
piano	48	14
saxophone	2	1
string	0	0
tambourines	1	0
triangles	31	0
trombone	2	0
trumpet	10	2
tuba	2	0
viola	3	0
violin	17	7
wind	7	0
xylophones	2	1
	—	—
Total	328	55
Average	10.5	1.71

High Frequency Concept: by Grade and by Content Area

PLANT KINGDOM

<u>Words</u>	<u>Gr. 6</u>	<u>Sc.</u>
algae	13	45
bacteria	88	191
cedars	0	0
club-mosses	—	—
cones	6	25
evergreens	3	1
ferns	2	16
firs	5	1
flowers	137	150
fruits	48	75
fungi	22	83
grains	57	33
grasses	120	99
horsetails	0	1
liverworts	0	3
mildew	0	0
molds	22	91
mosses	5	31
mushrooms	15	25
pin	3	3
puffballs	5	5
sea lettuce	—	—
seaweeds	1	2
seed plants	—	—
shrubs	5	12
simplest plants	—	—
spruces	5	2
toadstools	0	1
trees	254	170
true mosses	—	—
vegetables	45	51
yeasts	7	12
	—	—
Total	868	1128
Average	27.12	35.25

High Frequency Concept: by Grade and by Content Area

ANIMAL KINGDOM

<u>Words</u>	<u>Gr. 6</u>	<u>Sc.</u>
alligators	3	10
amphibians	13	38
bass	23	7
beavers	14	7
birds	169	245
bluejays	1	0
chimpanzees	1	0
cold-blooded	0	1
crows	0	0
dolphins	5	3
eagles	5	4
fish	172	231
frogs	52	66
goldfish	1	5
gorillas	2	1
hamsters	0	1
hummingbird	4	4
kangaroo	8	6
lizards	3	22
mammals	12	92
marsupials	3	3
men	464	141
monkeys	11	5
opossum	0	2
ostrich	4	4
pigeons	31	14
porpoises	1	3
primates	0	2
rabbits	23	25
rats	7	6
reptiles	31	91
robins	3	9
rodents	5	3
salamanders	5	7
salmon	22	75
sea-going	0	0
sharks	3	2
snakes	28	95
sparrows	1	6
squirrels	8	11
toads	50	55
trout	16	0
turtles	4	13
vertebrates	1	19
warm-blooded	0	0
whales	8	16
Total	1217	1350
Average	26.45	29.34

APPENDIX C

INSTRUCTIONAL MATERIALS

Passage For Musical Instruments

HOW MUSICAL INSTRUMENTS ARE CLASSIFIED

Almost all the instruments that produce music can be grouped in three major classes: string, wind, and percussion. They make sounds in three different ways. Vibrating strings produce the musical tones in the first group. Wind blown into or through a tube produces the tones in the second group. Something struck produces the sounds in the third group.

Stringed instruments are of three types - bowed, plucked and struck. In the first type, the string is bowed (rubbed with a bow) to produce sounds. The important bowed strings are the violin family, which includes the violin, viola, cello, and bass.

In the second type of stringed instrument, the player plucks the strings to produce tones. He may use his fingers, as in playing a harp. Or he may use a plectrum, a small piece of ivory, wood, or metal. The most important plucked-string instrument in an orchestra is the harp. Other plucked strings, usually played by themselves rather than with an orchestra, include the banjo and guitar.

In the third type, the string is hammered to produce a tone. The most important hammered-string instrument, the piano, is usually classed with keyboard instruments.

Wood-wind instruments are grouped together because at one time they were all made of wood. Today, they may be made of metal or plastic. Wood winds produce tones when the musician blows air into or through a tube, either directly or past a vibrating reed. He covers holes in the tube to play various tones. In the flute family, he blows across a hole in the tube. Two thin pieces of reed, vibrating together, produce the sound in the bassoon, oboe, and English horn. A single reed, vibrating against a slot in the mouthpiece, produces the sound in the clarinet and saxophone families.

Brass instruments all have rather long bores (tubes) with mouthpieces at one end and flaring bells (openings) at the other. Many brass instruments have valves that serve to lengthen or shorten the tube, lowering or raising the pitch. The horn family has a narrow, conical bore, with a funnel-shaped mouthpiece and a large bell. The trumpet family has a narrow, cylindrical bore, a cup-shaped mouthpiece, and a moderate-sized bell. The cornet has a cup mouthpiece and a bore that is partly conical and partly cylindrical. The bugle has a cup mouthpiece, a wide, conical bore, and a moderate bell. The trombone family has a larger mouthpiece than the trumpets, and usually has a slide instead of valves to lengthen the bore. The tuba family has a wide, conical bore and a cup mouthpiece.

Percussion instruments include two basic types: those that play definite pitches and those that produce indefinite pitches. Kettledrums can be tuned to specific pitches, and are

grouped with bells, and xylophones. Indefinite pitch instruments include the drum family (except kettledrums) and castanets, cymbals, tambourines, triangles, and many others.

Adapted from

"What are the different kinds of musical instruments?", Concepts and Challenges in Science 3, Canadian Sl Edition: Wolfe et. al, Macmillan of Canada, Toronto, Ontario, 1979, 144 and "Musical Instruments", The World Book Encyclopedia, 1977, 786-88.

Other Passages:

"How Would We Classify John Gorilla?" Be a Better Reader, Book I, Nila Banton Smith, Prentice-Hall, Ontario, 1974, 26-27.

"To What Classification Does the Raintree Belong?" Be a Better Reader, Book I, Nila Banton Smith, Prentice-Hall, Ontario, 1974, 60-61.

"Rocks and Minerals Around Us" Science is Experimenting, Otho E. Perkins, Cambridge Work-A-Text, Cambridge Book Company, New York, 1974, 109-112.

Cloze Instruction

Name: _____

Date: _____

ANIMAL KINGDOM

Scientists classify animals as _____ and invertebrates. These two large groups are then divided into smaller groups of animals which have certain similarities. Two classes of vertebrates are _____ and _____.

The cold-blooded vertebrates are classified into three groups. The first group, the _____ live in water and have no lungs, but breath through gills. G _____, s _____, t _____, b _____, and sh _____ are examples of this class. The second group is called _____. Amphibians do not stay in the water all the time so they need both gills and lungs for breathing. F _____, t _____, and s _____ are all amphibians. The third group is different from both fish and amphibians in that they never have gills. The _____ have lungs and breath through them all the time. Sn _____, t _____, l _____ and a _____ belong to this group.

The other class of vertebrates is the class to which warm-blooded animals belong. There are two important groups under this class of vertebrates. _____ and _____. The first group has wings and their bodies are covered with feathers. Some, like the _____, weight less than a penny. Others, like the _____, weigh as much as 300 pounds. Sp _____, r _____, bl _____, c _____, p _____, and e _____ belong to this group.

The second important class of warm-blooded vertebrates have at least some hair or fur. Mammals feed their babies with milk. There are many groups of mammals. _____ carry their young in a pouch. The _____ and the _____ are examples of marsupials. Scientists classify wh _____, d _____, and p _____ as _____ mammals because they have flesh covered "hands" or flippers. These sea-going mannals also feed their babies with milk. The _____ are fur covered mammals with sharp, chisel-shaped teeth which they use for gnawing. R _____, b _____, rab _____, h _____, and sq _____ are all rodents. The members of the _____ group have hands which they can use to grasp objects. Some of them can stand upright on two feet. M _____, g _____, ch _____, and m _____ all belong to the group of primates.

Adapted from

"How Would We Classify John Gorrila?" Be a Better Reader, Book I,
Nila Banton Smith, Prentice-Hall, Ontario, 1974, 26-27.

Cloze Instruction

Name: _____

Date: _____

PLANT KINGDOM

The plant kingdom can be classified into four main groups. The four main groups are (1) _____, (2) _____, (3) _____, (4) _____. The simplest plants have neither roots, stems or leaves. This group is usually sub-divided into two classes: _____ and _____.

The algae class consists of simple plants which have a green colouring matter, called chlorophyll. We see it floating on ponds or on the side of fish tanks. Larger plants in this class are the _____ and _____.

The fungi class consists of simple plants which do not have any chlorophyll. B _____ and y _____ are two of the over 75,000 varieties of plants included in the fungi class. The _____ which you have seen growing in coloured patches on bread, fruit and other foods are also classified as fungi.

_____ is a mold that grows on damp cloth or paper. Another great group of fungi includes m _____ and p _____. There are two kinds of mushrooms, those that are safe to eat and those that are poisonous. The poisonous ones are often called s _____.

The second main group differs from the simplest plants in that they have rootlike or leaflike parts. There are two classes of mosses: the _____ and the _____. The true mosses differ from the liverworts in that they have true stems which allow them to stand upright.

The third main group of the plant kingdom are the ferns. The ferns have true roots, stems and leaves. In addition to the plants known as ferns, the _____ and the _____ belong to this group. Scientists classify horsetails as a fern even though it doesn't look like one. It has long stiff rough stems with clusters of spine-like leaves. They look very different from the club mosses which have long roots that grow horizontally and small green leaves that stay close to the ground.

The fourth group or the simplest plants make up the greatest number of all plant groups. The main reason for this is that they reproduce from seeds rather than spores. There are two main classes of seed plants, those with _____ and those with _____. The plants with cones do not produce flowers. These plants usually have needle-shaped leaves that remain on the plants all year long. The c _____, such as p _____, s _____, f _____, and c _____ are members of this class.

The rest of the seed plants have flowers, and their flowers produce seeds. This class includes all f _____, v _____ gr _____, and gr _____. It also includes most tr _____ and shr _____ that lose their leaves in autumn.

Adapted from

"To What Classification Does the Raintree Belong?"

Be a Better Reader, Book I, Nila Banton Simth, Prentice-hall, Ontario, 1974, 60-61.

Cloze Instruction

Name: _____
Date: _____

MUSICAL INSTRUMENTS

Musical instruments are grouped in three major classes: s _____, w _____, and p _____. They make sounds in three different ways. Vibrating strings produce the musical tones in the first group. Wind blown into or through a tube produces the tones in the second group. Something struck produces the sounds in the third group.

The important bowed strings include v _____, v _____, c _____ and b _____. In the second type of stringed instruments, the player plucks the strings to produce tones. The h _____, b _____, and g _____ are examples of these instruments. The string is hammered in the third type and the most important hammered - string instrument is the p _____.

Wood-wind instruments are divided into two groups: wind and b _____. In wood winds the player covers holes in the tube to play various tones. The f _____, b _____, o _____, and e _____ are some examples. Other examples with a single reed vibrating against a slot in the mouthpiece are the c _____ and the s _____.

The brass instruments which are also classed as winds have rather long tubes with mouthpieces at one end and flaring openings at the other. Many brass instruments have valves that serve to lengthen or shorten the tube, lowering or raising the pitch. The h _____, tr _____, c _____, b _____, tr _____, and t _____ are examples of brass instruments.

Percussion instruments include two basic types: those that play definite pitches and those that produce indefinite pitches. K _____ can be tuned to specific pitches, and are grouped with b _____ and x _____. Indefinite-pitched instruments include the d _____ family and c _____, cy _____, t _____, and tr _____.

Adapted from
Project Developed Passage
For Musical Instruments.

Cloze Instruction

Name: _____

Date: _____

ROCKS & MINERALS

Rocks are grouped or classified according to the way they are formed. Geologists divide them into three main groups of natural rocks. They are _____, _____, and _____. Igneous rock is composed mainly of the common minerals quartz, feldspar, hornblende and mica. One type of igneous rock is used in buildings, and monuments. It is called _____ and is made up of the four common minerals _____, _____, _____, and _____. The second type of igneous rock is called _____. It is made up of dark-coloured feldspar. Basalt has very small crystals. The third type of igneous rock is shiny and slick like glass. _____ is sometimes known as volcanic glass. The Indians prized Obsidian because it was sharp and held its edge. Thus it was excellent for tools and weapons. The fourth type of igneous rock is called _____. It is crowded with bubbles and small holes that were caused by gas escaping as the rock cooled. Because of these holes pumice is so light that it will float in water.

The second main group of natural rocks are called sedimentary rock. There are five types of sedimentary rocks. _____ is the most plentiful form of sedimentary rock. Shale is really made up of mud and clay. The second type of sedimentary rock is called _____. It is gray, white, red, or brown. Sandstone is used as building stone and in making glass. _____, the third type is formed from shells of dead sea animals. It varies in colour, but is usually a shade of gray. Limestone is ground up for cement. The fourth type called _____ looks like concrete. It is rough and bumpy. Conglomerate rock is used as building stone. The last type of sedimentary rock is known as "soft coal" and is called _____. It is made of carbon and comes from the remains of plants. Bituminous coal is widely used as a fuel.

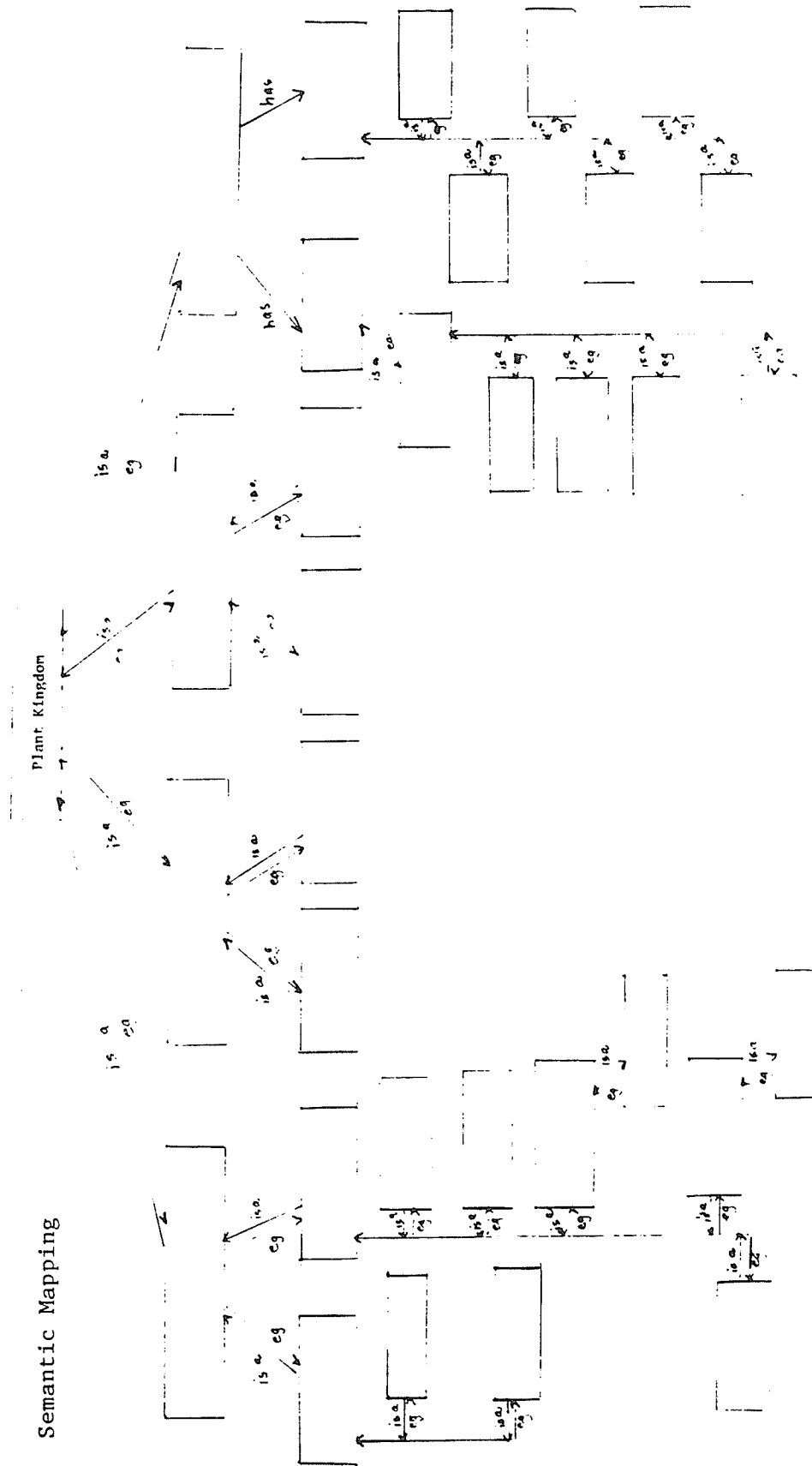
The third main group of natural rocks are called metamorphic rocks. At one time metamorphic rocks may have been either igneous or sedimentary. They have been changed by heat and pressure and they no longer look like the original rock. Six types of metamorphic rocks are gneiss, schist, marble, slate, quartzite, and anthracite coal. If examined in sequence these six types can be identified. In _____ minerals are arranged in bands of light-coloured then dark-coloured minerals. _____ has its minerals arranged in parallel bands. _____ is very hard and crystalline. It is used in buildings and statues. _____ is made of mud and clay. It can be split into thin sheets and was once used for making blackboards. _____ was originally sandstone and is used as a building stone. _____ is chiefly carbon and is called "hard coal". Like bituminous coal, it is used as a fuel.

Adapted from

"Rocks and Minerals Around Us"

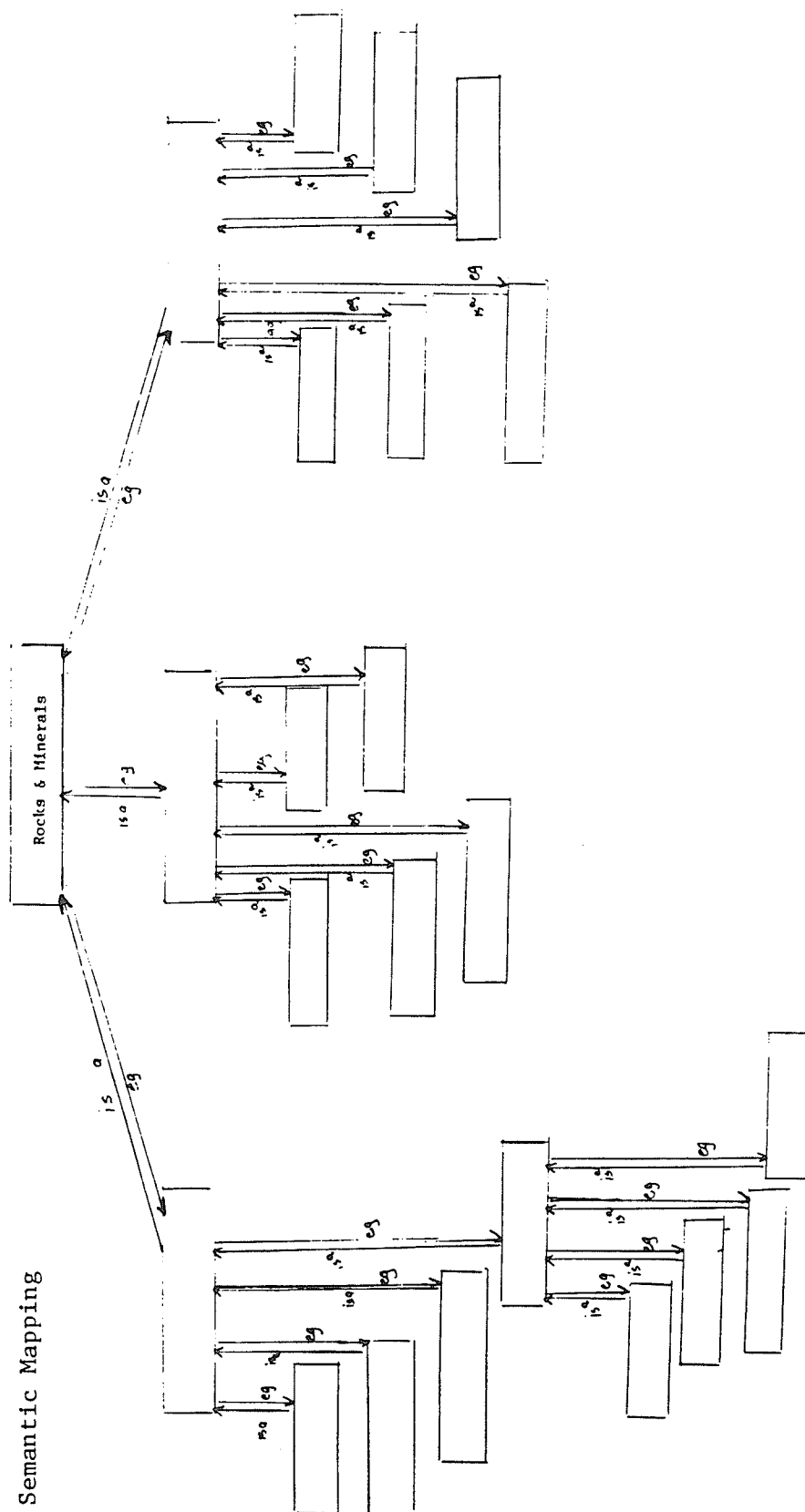
Science Is Experimenting, Otho E. Perkins, Cambridge Work-A-Text, Cambridge Book Company, New York, 1974, 109-112.

Semantic Mapping

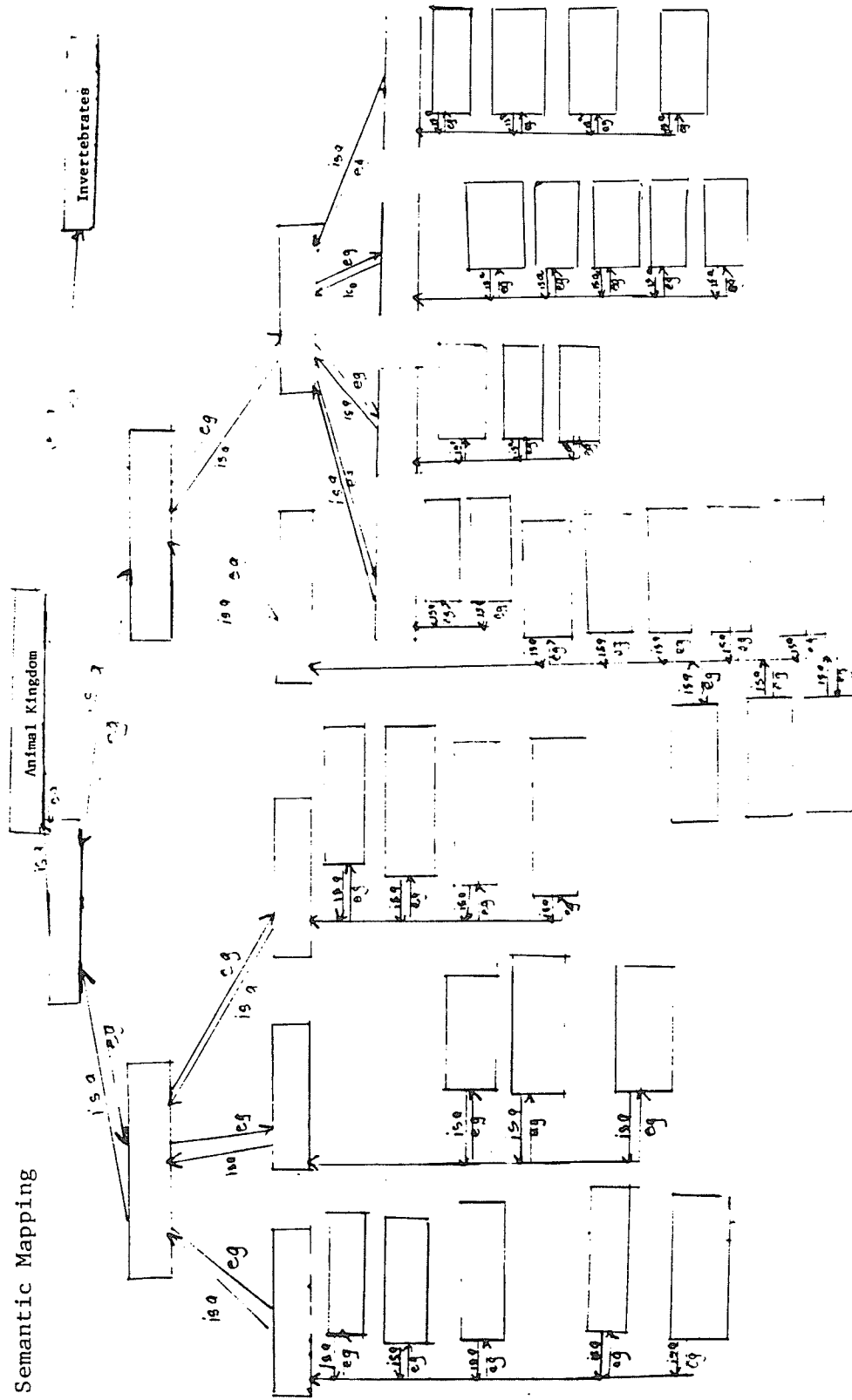


Semantic Mapping





Semantic Mapping



Category Match	ANIMAL KINGDOM		Name: _____
	Vertebrates		Date: _____
	<u>Cold-blooded</u>	<u>Warm-blooded</u>	
<u>Fish</u>	<u>Amphibians</u>	<u>Birds</u>	<u>Mammals</u>
	<u>Reptiles</u>		

primates	goldfish	toads	porpoises
salmon	frogs	snakes	hummingbird
ostrich	marsupials	kangaroo	turtles
rabbits	monkeys	sparrows	rats
trouts	alligators	gorillas	lizards
beavers	opossum	dolphins	robins
bass	salamanders	bluejays	rodents
men	hamsters	squirrels	chimpanzees
pigeons	eagles	sharks	crows
sea-going mammals			whales

Category Match

Name: _____
Date: _____

PLANT KINGDOM

Simplest Plants Mosses Ferns Seed Plants

liverworts	seaweeds	puffballs	club mosses
flowers	bacteria	spruces	grains
yeast	true mosses	mushrooms	grasses
evergreens	algae	fungi	sea lettuce
fruits	horsetails	vegetables	cones
cedars	trees	pinos	molds
toadstools	firs	mildew	shrubs

Category Match
Answer Key

PLANT KINGDOM

<u>Simplest Plants</u>	<u>Mosses</u>	<u>Ferns</u>	<u>Seed Plants</u>
algae	liverworts	horsetails	cones
seaweeds	true mosses	club mosses	evergreens
sea lettuce			pin
fungi			spruces
bacteria			firs
molds			cedars
mildew			flowers
yeasts			fruits
mushrooms			vegetables
puffballs			grains
toadstools			grasses
			trees
			shrubs

Category Match

Name: _____

MUSICAL INSTRUMENTS

Date: _____

StringBrassWindPercussion

harp
trumpet
banjo
clarinet
bassoon
castanets
bass

xylophones
guitar
viola
cello
cornet
horn
flute

bells
triangles
cymbals
violin
piano
English horn
kettledrums

tambourines
oboe
bugle
tuba
saxophone
trombone
drum

Category Match
Answer Key

MUSICAL INSTRUMENTS

<u>Strings</u>	<u>Brass</u>	<u>Wind</u>	<u>Percussion</u>
violin	bugle	flute	bells
viola	cornet	oboe	castanets
cello	trumpet	English horn	cymbals
bass	trombone	clarinet	kettledrums
banjo	tuba	saxophone	tambourines
guitar	horn	bassoon	triangles
harp			xylophone
piano			drum

Category Match

Name: _____

Date: _____

ROCKS & MINERALS

Igneous

Sedimentary

Metamorphic

anthracite coal
obsidian
mica
hornblende
marble
conglomerate
schist

bituminous coal
pumice
sandstone
slate
granite
quartz

feldspar
shale
gneiss
limestone
quartzite
basalt

Category Match
Answer Key

ROCKS & MINERALS

<u>Igneous</u>	<u>Sedimentary</u>	<u>Metamorphic</u>
granite	shale	gneiss
feldspar	sandstone	schist
quartz	limestone	marble
mica	conglomerate	slate
hornblende	bituminous coal	quartzite
basalt		anthracite coal
obsidian		
pumice		

Ten General Questions For the
Story Discussion Treatment

1. Why do you think this story has this particular title?
2. Did the definitions at the bottom of the page assist you in reading the story? How many did not even notice them?
3. Was this story new information to you? In what way?
4. To what subject area do you think this story belongs? What makes you think so? How many really like this subject? Why?
5. Is this the type of story you like to read? Why or Why not?
6. Have you read similar stories? Can you share one?
7. Would you like to know more about this topic? Why? What?
8. Where would you locate information on this topic?
9. Did the pictures assist you in understanding the story? In what way?
10. When you look at the pictures does it create a scene or an image in your mind? Can you describe it?

APPENDIX D

MEANS AND STANDARD DEVIATIONS FOR INTERACTIONS

A Comparison of Means and Standard
Deviations For Differences in Passages
For Particular Treatment and Time Combinations

Frequency Passage Treatment	HF Animal Pre	vs. SD	Post	LF Rock SD
CL	4.000* 0.466	1.732 0.743	5.666 7.266	2.093 4.283
SM	3.000 1.133	2.267 0.833	7.600 8.066	6.511 4.267
CM	3.200 1.066	2.210 0.883	8.200* 4.866	4.345 3.181
SD	2.866 0.600	2.559 1.055	5.200 2.133	2.624 2.199
* c.v. at $\alpha = .05$ for $df = 9, 314 = 2.817$				

A Comparison of Means and Standard
Deviations For Differences in Passages
For Particular Treatment and Time Combinations

Frequency Passage Treatment	LF Music Pre	vs. SD	Post	LF Rock SD
CL	8.666* 0.466	3.086 0.743	12.333* 7.266	3.658 4.283
SM	9.066* 1.133	2.051 0.833	13.400* 8.066	4.732 4.267
CM	7.466* 1.066	1.922 0.883	10.000* 4.866	2.976 3.181
SD	6.466* 0.600	2.614 1.055	8.066* 2.133	2.631 2.199

* c.v. at $\alpha = .05$ for $df = 9, 314 = 2.817$

A Comparison of Means and Standard Deviations For Differences In Treatments For Particular Passage and Time Combinations

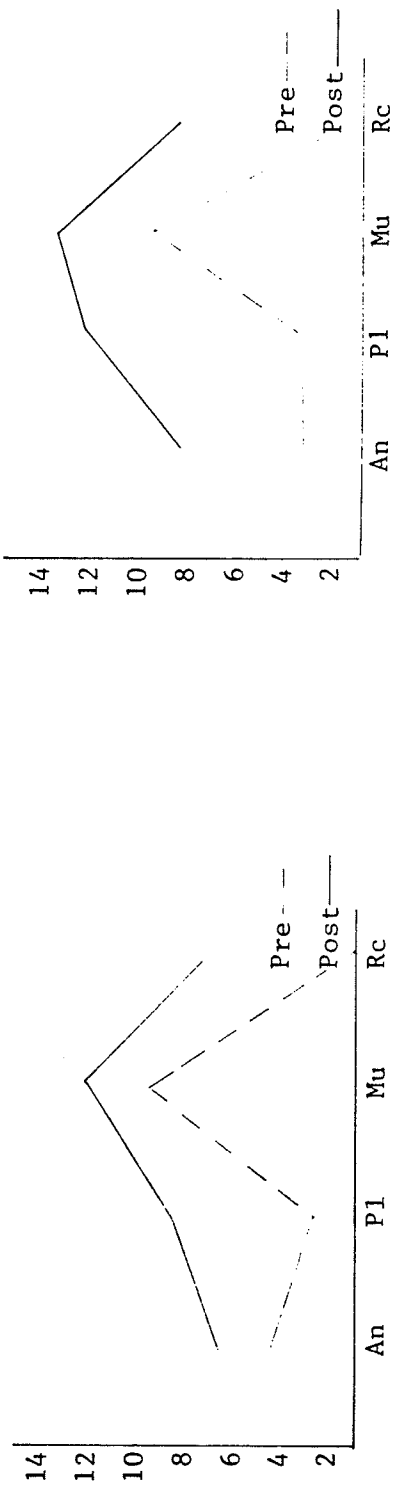
Treatment	CL	vs.	SD	SD
Passage	Pre			
		Post		
Animal	4.000	1.732	5.666	2.093
	2.866	2.559	5.200	2.624
Plant	2.333	1.496	8.466*	4.454
	2.266	1.437	2.800	2.808
Music	8.666	3.056	12.333*	3.658
	6.466	2.614	8.066	2.631
Rock	.466	0.743	7.266*	4.283
	0.600	1.055	2.133	2.199

c.v. at $\alpha = .05$ for $df = 32, 00 = 2.817$

APPENDIX E

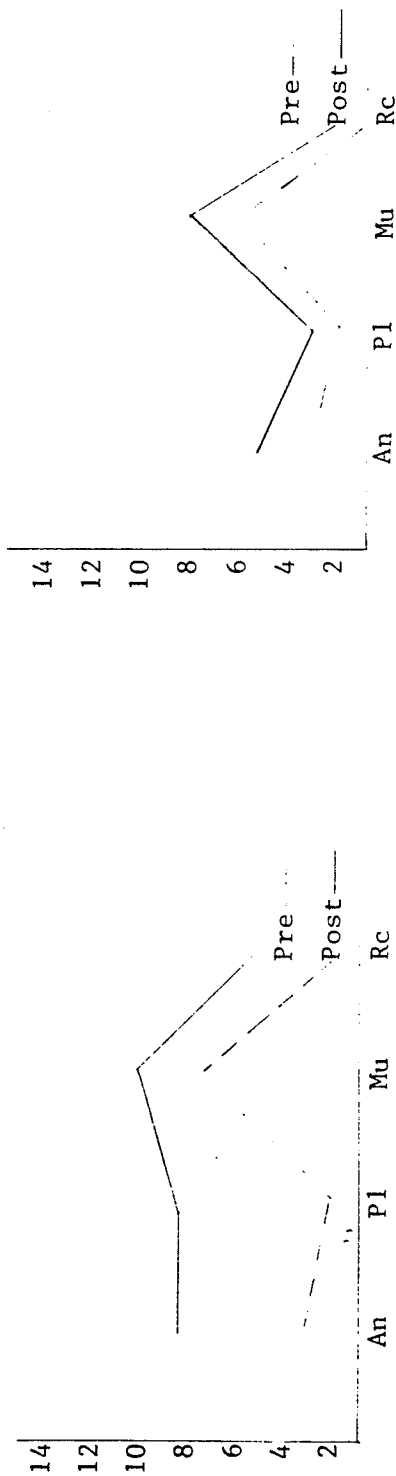
GRAPH REPRESENTATION OF INTERACTIONS

Comparison of Pre- to Post-Test Gain



(a) Cloze

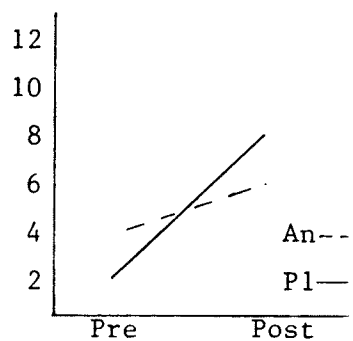
(b) Semantic Mapping



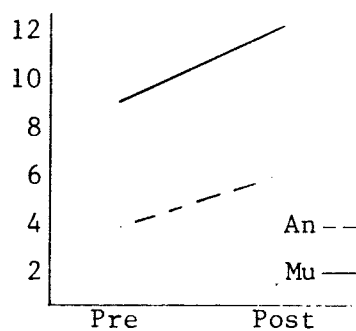
(c) Category Matching

(d) Story Discussion

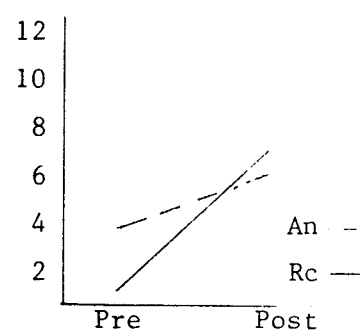
Comparison of Passages (CL)



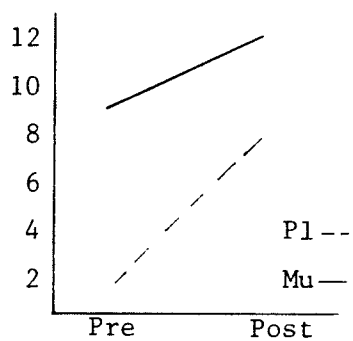
(a) Animal vs. Plant



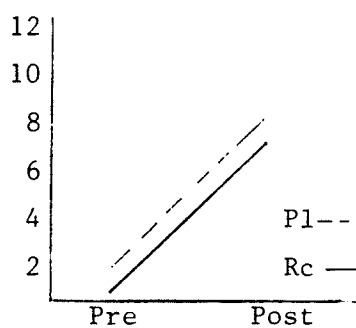
(b) Animal vs. Music



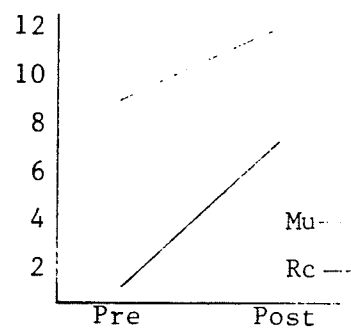
(c) Animal vs. Rock



(d) Plant vs. Music

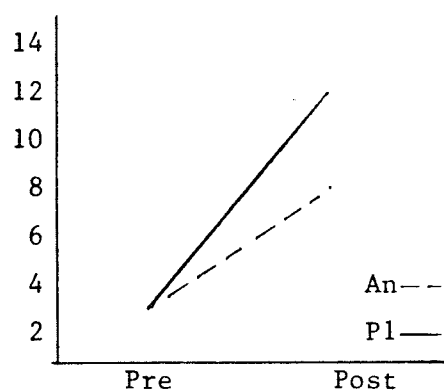


(e) Plant vs. Rock

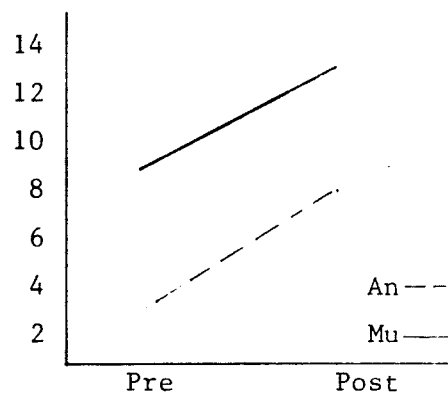


(f) Music vs. Rock.

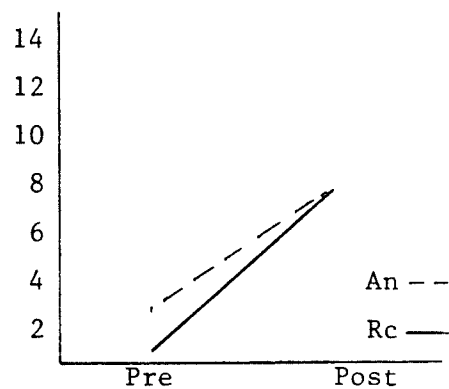
Comparison of Passages (SM)



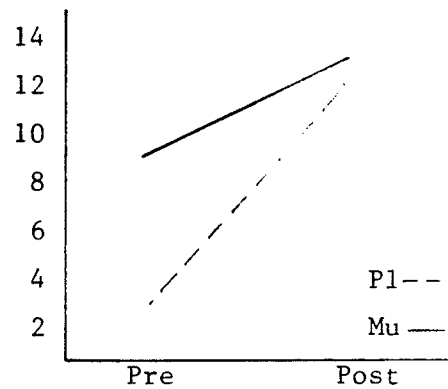
(a) Animal vs. Plant



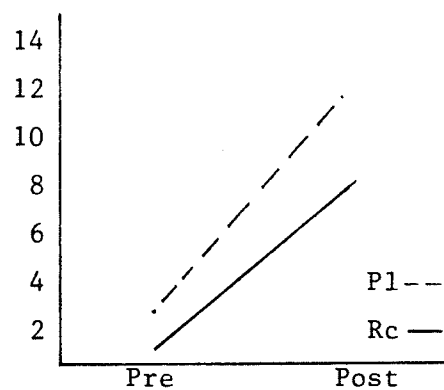
(b) Animal vs. Music



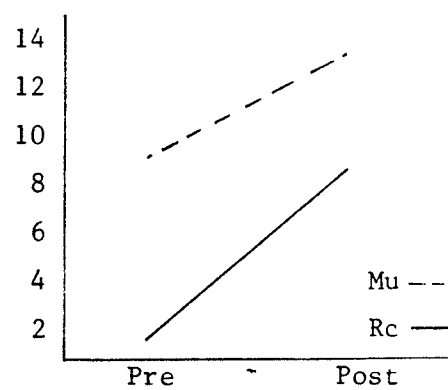
(c) Animal vs. Rock



(d) Plant vs. Music

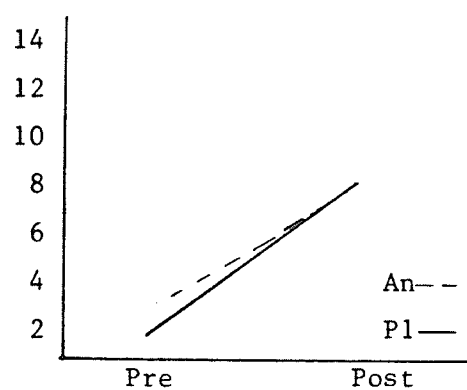


(e) Plant vs. Rock

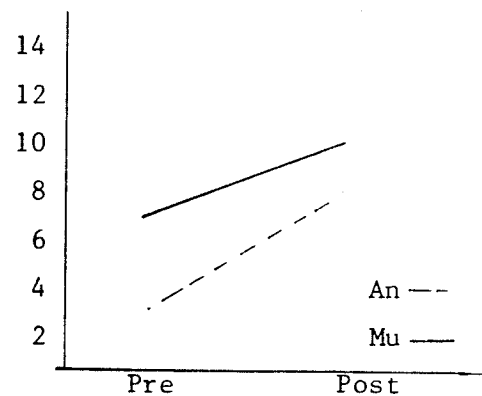


(f) Music vs. Rock

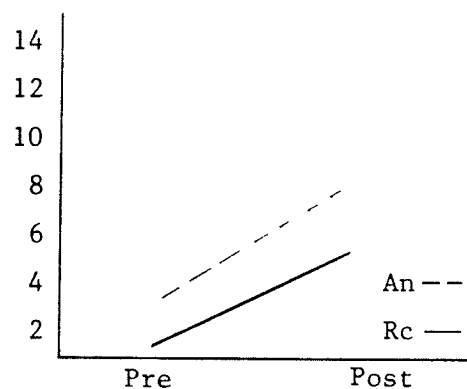
Comparison of Passages (CM)



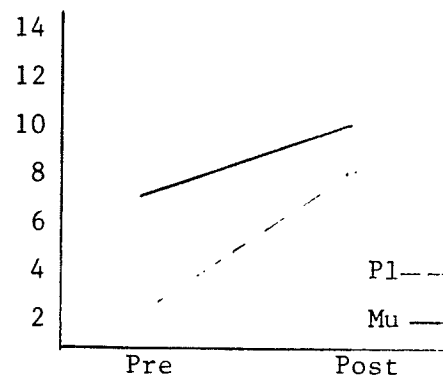
(a) Animal vs. Plant



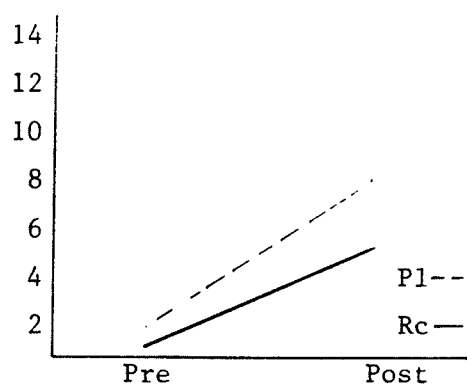
(b) Animal vs. Music



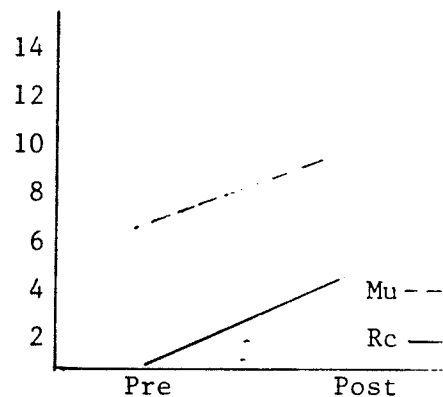
(c) Animal vs. Rock



(d) Plant vs. Music

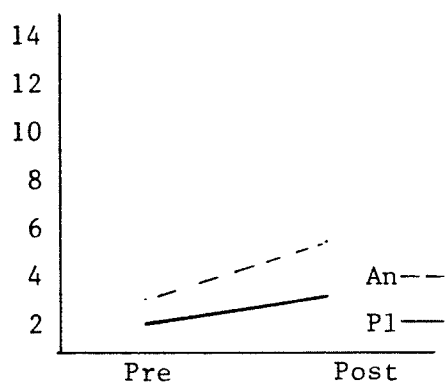


(e) Plant vs. Rock

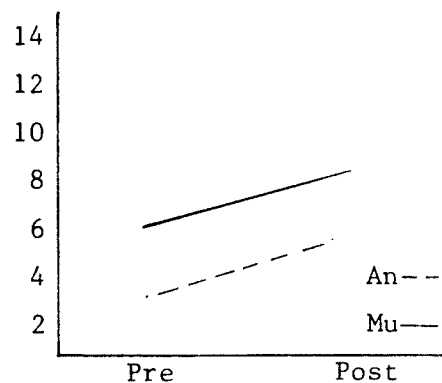


(f) Music vs. Rock

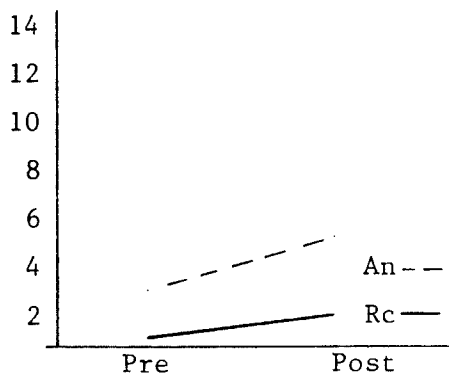
Comparison of Passages (SD)



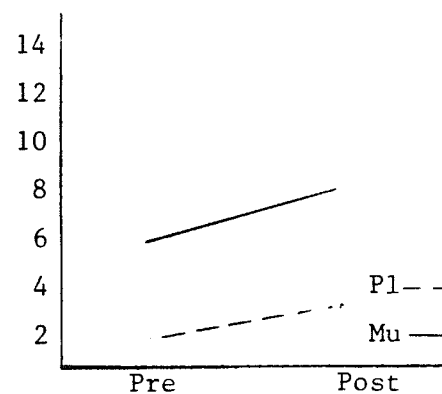
(a) Animal vs. Plant



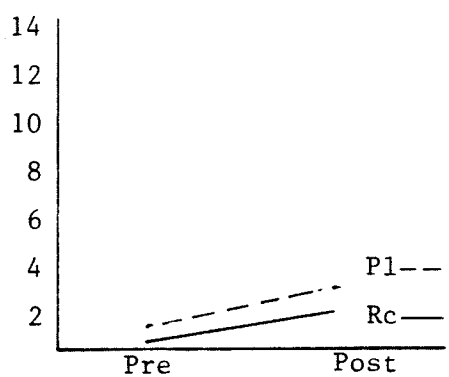
(b) Animal vs. Music



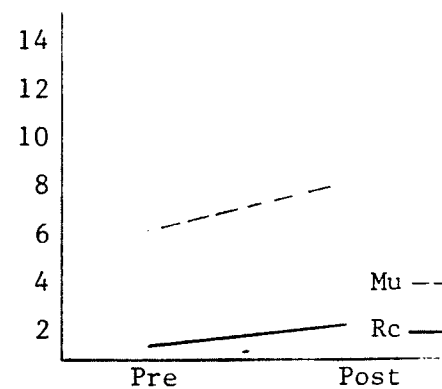
(c) Animal vs. Rock



(d) Plant vs. Music

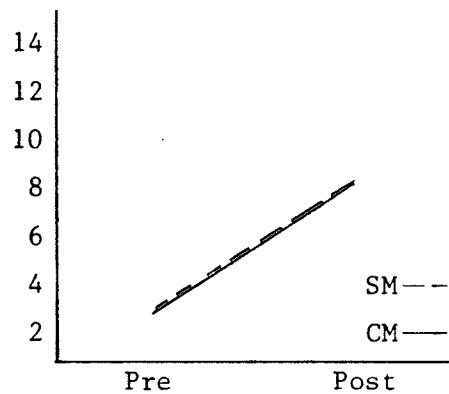


(e) Plant vs. Rock

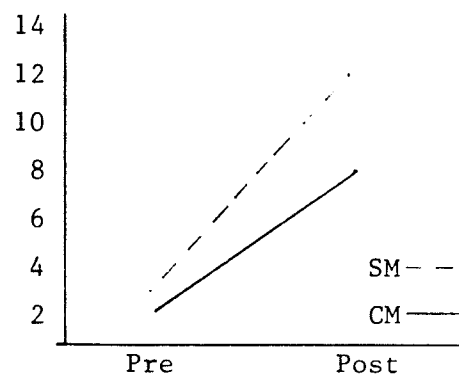


(f) Music vs. Rock

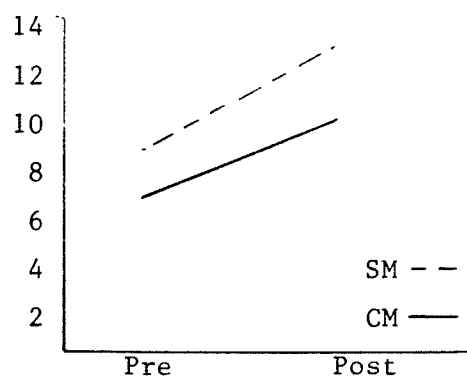
Comparison of Treatments (SM vs. CM)



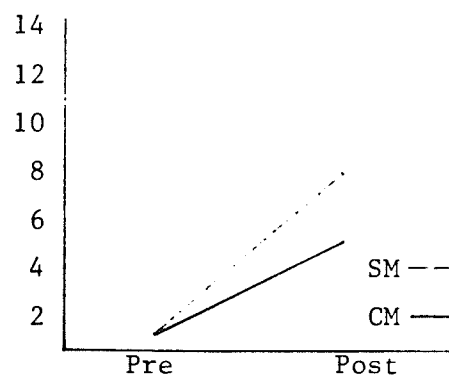
(a) Animal Passage



(b) Plant Passage

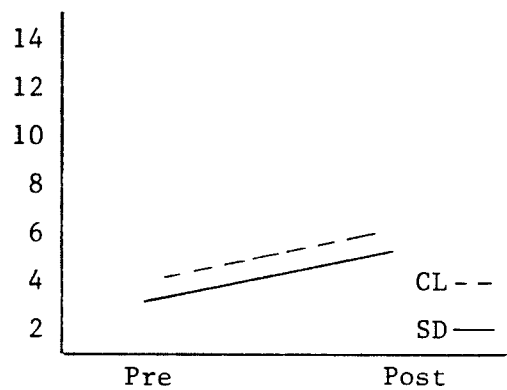


(c) Music Passage

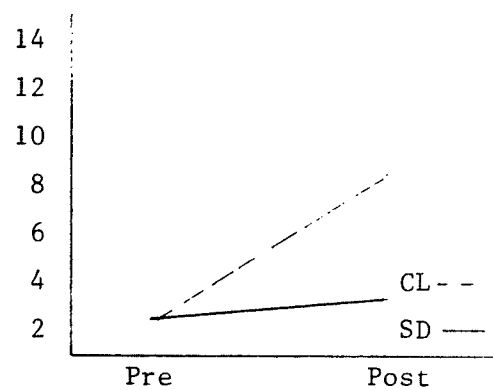


(d) Rock Passage

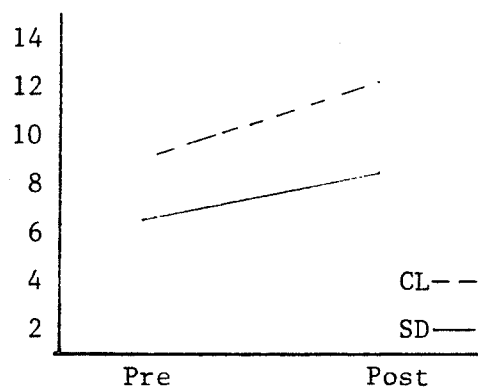
Comparison of Treatments (CL vs. SD)



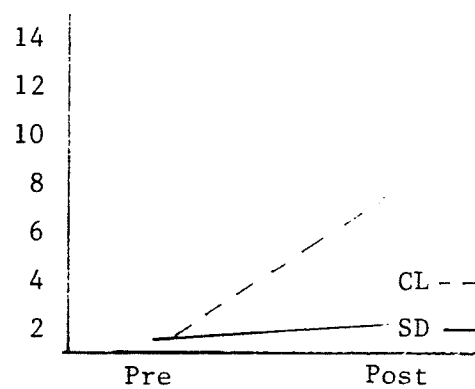
(a) Animal Passage



(b) Plant Passage

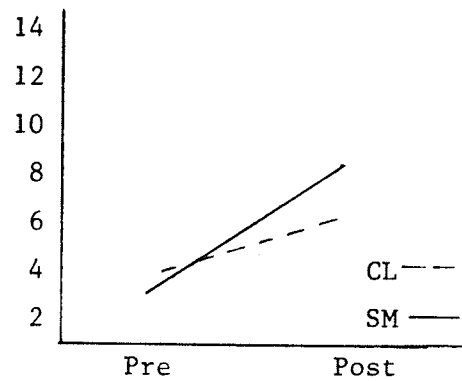


(c) Music Passage

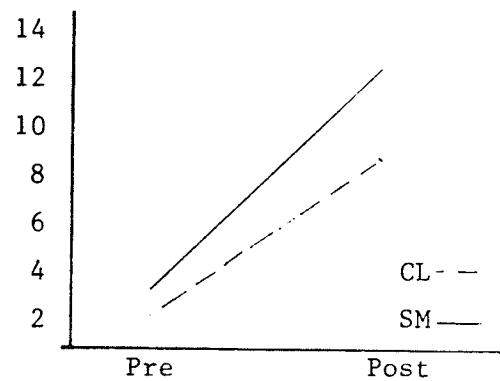


(d) Rock Passage

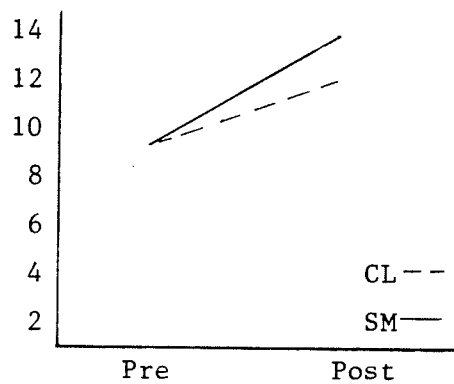
Comparison of Treatments (CL vs. SM)



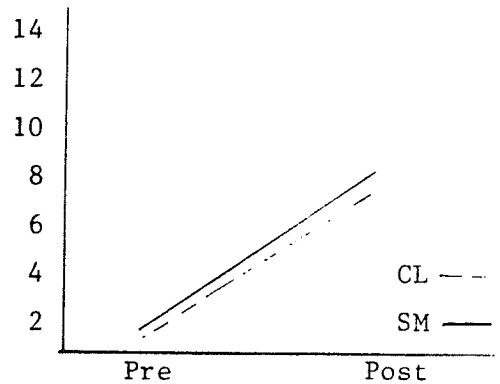
(a) Animal Passage



(b) Plant Passage

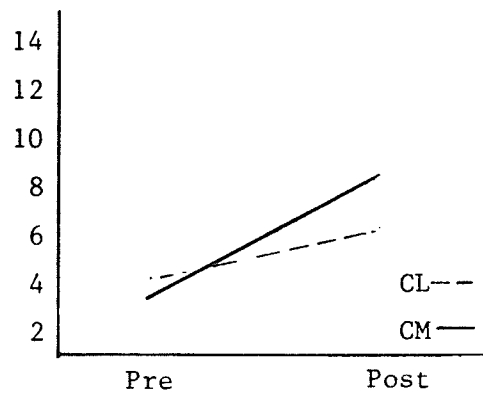


(c) Music Passage

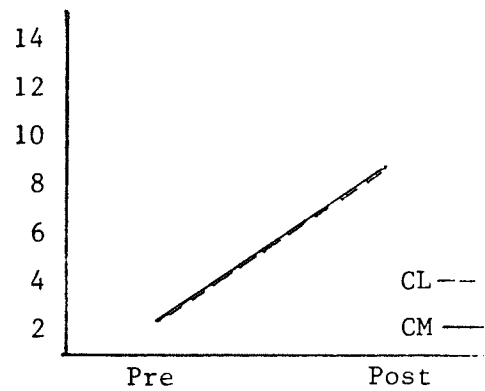


(d) Rock Passage

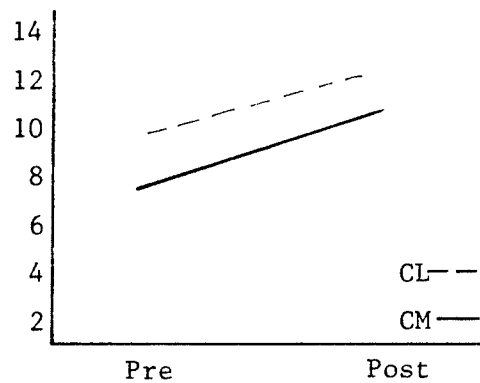
Comparison of Treatments (CL vs. CM)



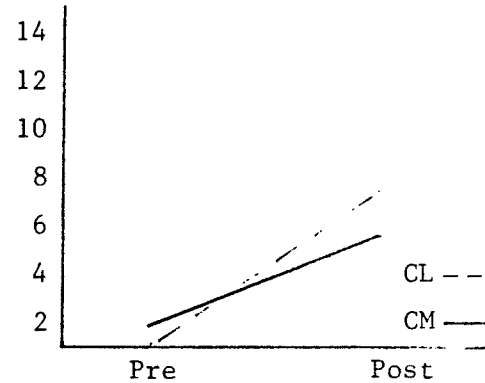
(a) Animal Passage



(b) Plant Passage

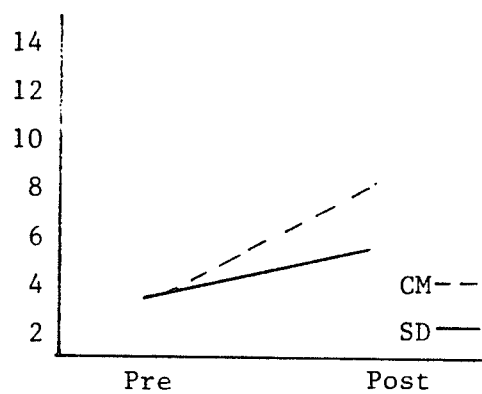


(c) Music Passage

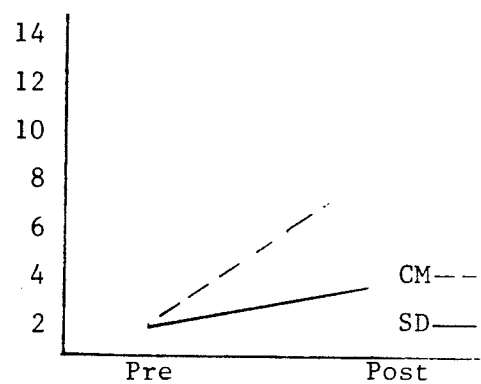


(d) Rock Passage

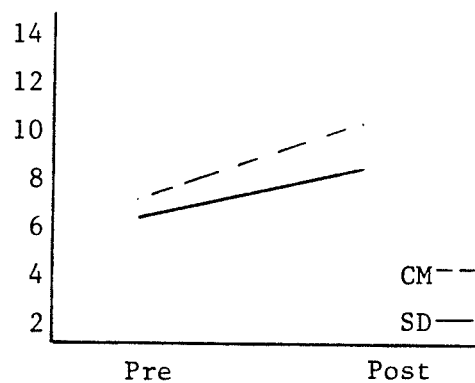
Comparison of Treatments (CM vs. SD)



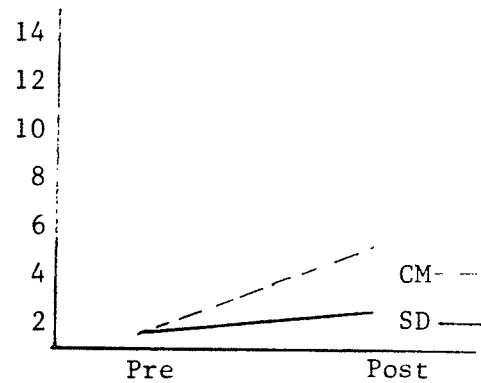
(a) Animal Passage



(b) Plant Passage

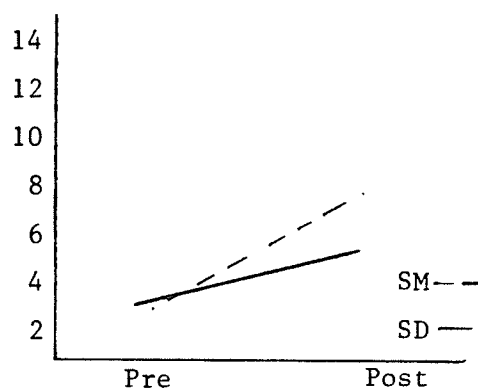


(c) Music Passage

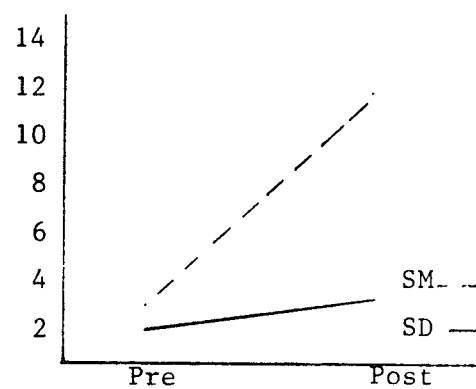


(d) Rock Passage

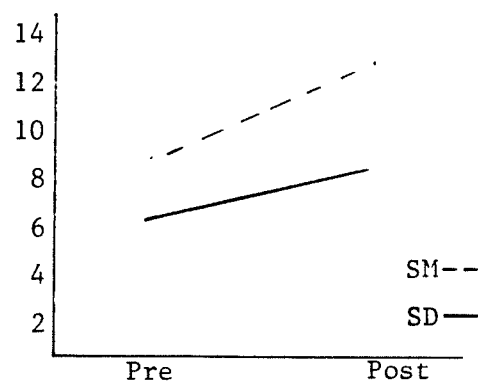
Comparison of Treatments (SM vs. SD)



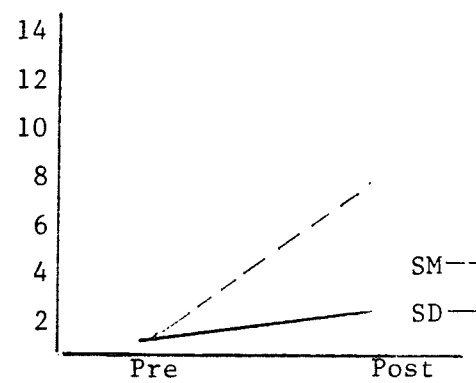
(a) Animal Passage



(b) Plant Passage



(c) Music Passage

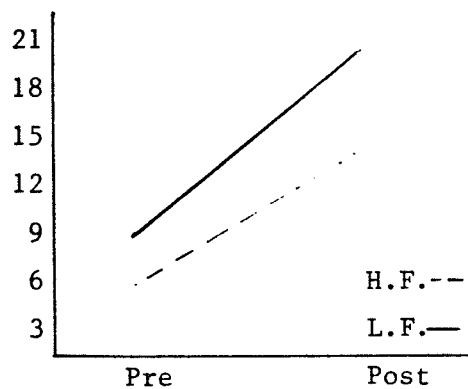


(d) Rock Passage

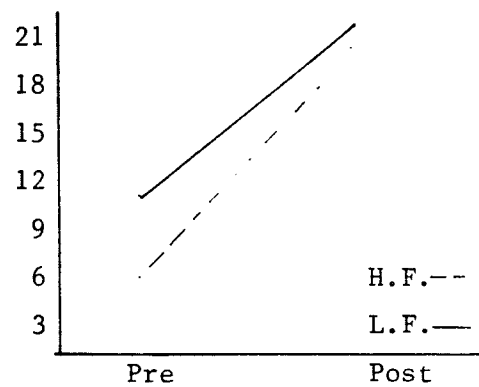
Comparison of High Frequency

(Animal and Plant)

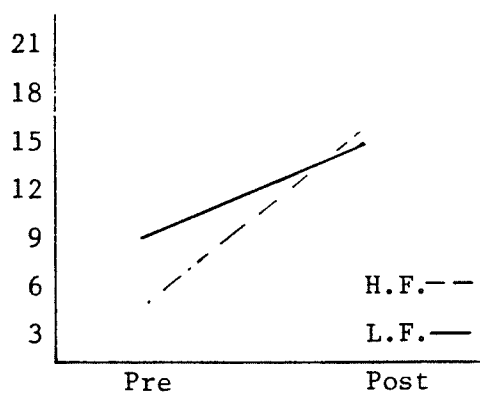
and Low Frequency (Music and Rock) Passages



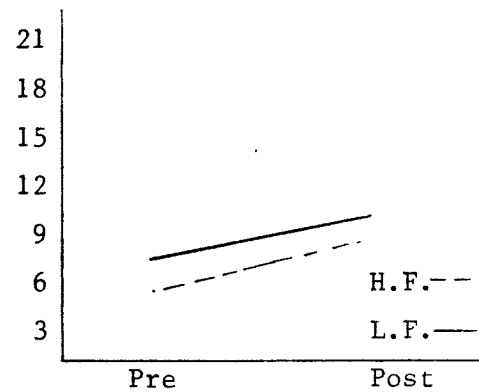
(a) Cloze



(b) Semantic Mapping



(d) Category Matching



(e) Story Discussion