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SCARBOROUGH, JULE DEE

THE EFFECTS OF TEXTUAL ORGANIZATION, VISUALS, AND ENACTIVE PERFORMANCE ON COMPREHENSION OF TECHNICAL TEXTUAL DISCOURSE

The Ohio State University

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THE EFFECTS OF TEXTUAL ORGANIZATION, VISUALS, AND ENACTIVE PERFORMANCE ON COMPREHENSION OF TECHNICAL TEXTUAL DISCOURSE

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

Jule Dee Scarborough, B.S., M.A.

* * * * *

The Ohio State University

1981

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Dedicated to
Mom and Dad
for they are the ones
who teach us how
to set and achieve
goals
ACKNOWLEDGMENTS

Achievement rarely occurs as a result of the work of a single person. Many are usually involved. Their roles range from small to great; however, one is no less important than the other, because each contributes to parts of the whole. That whole would not exist without each of those parts. With appreciation I acknowledge those who contributed to this learning experience:

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Donald G. Lux          Nancy Kadunc
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The junior high division of Manteo High School; the administrators, teachers, and students. . .
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CHAPTER I

INTRODUCTION

"Demonstration" is the teaching method most commonly used in the field of industrial arts (Maley, 1978). Demonstrations can be said to be "episodically" organized. There is a temporal sequence important between the events within an episode and a temporal sequence important between the episodes. Most industrial arts literature (books) and activities are episodically organized. However, there has been a recent attempt within the field to structure concepts hierarchically, (e.g. efforts of the American Industry Project, work by DeVore et al. and materials published by the Industrial Arts Curriculum Project). Therefore, industrial arts educators have attempted both methods of organizing material over the years. There remains, however, much studying to decide if one method or organization is better or if a combination of the two would improve the organization and presentation of instructional materials in this field.

Industrial arts teachers traditionally focus upon non-verbal manipulation of tools, machines, and materials rather than language experiences. We must recognize that to really process and comprehend technical information, experiences of both kinds are vital. Knowledge is manipulated by way of language as well as the senses; thus one can not adequately manipulate the knowledge base of our field without both language and psychomotor skills. Professionals and
students in industrial arts must become immersed in the language of the field because the language is the representation of the knowledge taught.

Learners often sit through a lecture or demonstration and realize after it is over that they can not recall, much less explain to another, what was presented. In fact, it happens much more often than educators would like to believe or admit. An early interest of this researcher was the technical vocabulary which is so much a part of the discipline or field, industrial technology. If technical educators are not proficient with the many technical terms necessary to the field, they cannot function or perform adequately within the field.

Technical terminology is only the superficial problem. There are several more deeply rooted problems with which one has to deal before tackling the problem of vocabulary, technical or common. Several of those problem areas are concepts and concept development, language and semantics, memory and recall, and finally, discourse and comprehension. These are but a few of the problems encountered during the process of studying any part of the information processing, but each of these could not be identified or studied without the "speech sound or series of speech sounds that symbolizes and communicates a meaning without being divisible into smaller units capable of independent use" called a word (Webster, 1973, p. 1340). Words give us language and with language and language skills we can manipulate knowledge, for language represents knowledge.
Within education one of the most difficult problems to resolve is that of connected discourse comprehension, oral or written. Speakers and writers, in organizing their texts, often do not take into consideration the involved process of comprehension which has to occur for a listener or reader to understand or "comprehend" their text. Comprehension involves knowledge, and it is assumed that knowledge can be expressed in printed or spoken language and that a skilled reader or listener can acquire knowledge from reading or listening (Anderson et al., 1977). The words, sentences, and discourse, however, carry meaning and make up spoken or written knowledge have to be composed in such a way as to consider the receiver's world knowledge, his/her analysis of the text, and the characteristics of the message (Anderson et al., 1977). Local linguistic constraints have to be considered, and it must be remembered that meanings are derived from interaction of world knowledge and context. Inference is a very important factor, as well as syntax, but one can not expect to find all the necessary information for inference to be evident within the syntax. Finally, one must remember to consider the representation of textual discourse, words and sentences, in memory. Memory is a major part of comprehension, for one cannot demonstrate comprehension without some sort of retrieval of information from memory. Therefore, for one to retrieve information from memory, it has to be encoded into memory beforehand and then stored. The literature on memory recognizes two cognitive structures or organizations which are used for the purposes of
encoding and retrieval. They are "schematic" and "categorical" organization. At a very general level these two kinds of organization influence memory similarly; however, at a more specific level there are differences (Mandler, 1978). In the attempt to discover how discourse is represented in memory, researchers are attempting to discover if organizing texts similarly to memory structures would facilitate comprehension. If texts were organized similarly to memory structures of the receiver of the texts, encoding, storage, and retrieval could (or may) become a simpler and less time consuming process. Studies on memory indicate that the more complex a structure or organization in the presentation of categorized lists and/or stories the better the performance on recall (Bower, 1969; Mandler, 1978; Rumelhart & Ortony, 1977).

Background of the Study

Language is used to communicate knowledge. This section is presented to provide a brief background to several areas of knowledge (e.g. comprehension/language acquisition) related to this study. It is organized into five categories: experience, concepts, labels, words; context; knowledge integration and inference; semantic and episodic memory; and organization of texts. They serve the purpose of identifying the levels at which problems may occur within the total realm of comprehension.

Experiences, Concepts, Labels, Words

Webster (1973) defines discourse as "verbal interchange of ideas; conversation; formal and orderly and extended expression of
thought on a subject; connected speech or writing" (p. 323). One could conclude that connected speech is a series of words (concepts) structured syntactically and grammatically in the expression of thoughts. There are problems with connected discourse expression, just as there are with individual words. It is often difficult to express a single concept precisely with the correct word (label), because one cannot assume another's "world knowledge" (experience) is the same as his own. Different experiences could mean a different interpretation would be placed on a word. The same problem arises in connected discourse, the major difference being that one has to contend with interpreting a series of connected concepts which increases the difficulty of the process.

Language is a great tool, for by way of language experiences, concepts can be attained through representation by language rather than perceptible instances. Though it would seem best to attain concepts by way of direct contact with instances, as do children in most cases, older children and adults often learn new concepts by way of language experiences (Klausmier, 1974). The process that occurs involves a person, sets of already attained concepts, presentation of new concepts, and making use of presupposed concepts in presenting new ones. Thus, new combinations of old concepts and elaboration of old concepts, plus some new concepts, can equal a language experience which can and often does successfully replace a perceptible instance. This point, however, brings to bear problems that arise with language experiences. Without an exact experience
for reference, it is a more difficult process to represent or replace that experience with language. The context used is a crucial issue.

**Context**

New words and concepts are often presented such that one could glean the "meaning" of the word and/or the new concept from the context within which it is presented. Deighton (1959) maintains, however, that context does not reveal meanings as often as supposed. The context more often "determines" the meaning, rather than "reveal it. Context interpretation is also influenced by the reader's or listener's "world knowledge" (experiences), just as a single word is. Therefore, varying degrees of experience will cause interpretations to vary in language experiences. A second problem with the relationship between context and word is that the usual case is for context to reveal only one meaning of a word and/or one concept of a word, when in fact, one word (label) can have multiple meanings. To compound this aspect of the second problem is the individual's alteration of the meaning as he personally chooses to use it. Even though we choose to use a particular word with an accepted, standardized meaning, our personal context within which we use it influences the reader or listener during his interpretation. Still a third problem exists with context operation. Seldom does a contextual situation reveal the complete meaning of a word or explain completely a new concept. There is often actually very little clarification. In many cases a synonym is used, but synonyms are never exact equivalents of another word. In summarizing these
principles, context, more often than not, merely provides clues from which a reader or listener can infer the meaning. One can not grasp a complete new concept or meaning with only one encounter; it takes many encounters to develop an understanding of a new word. Meaning comes from experiences of both kinds, the greater the increase not only in the comprehension of a reader or listener, but the greater the potential for knowledge integration, and making inferences, as well.

Knowledge Integration and Inference

Knowledge integration plays an important role in comprehension. New knowledge must fit into that already attained. This may mean establishing a new category or assimilating the new into the old. New knowledge may add to that already present, or it may cause a change in some part of existing knowledge. Whatever, it must be fitted into the existing memory structure, or the structure must be adapted to include it.

Inference is a major factor which influences discourse comprehension. Clark (1977) speaks of comprehension as problem solving: determining what the speaker means directly (explicitly) and/or indirectly (implicitly). It is a process of deduction. Clark identifies the components of the process as: (1) registering what is presented; (2) taking into consideration the present circumstances; (3) considering the speaker and then understanding what is "given" between the speaker and listener (referred to as a contract for specific circumstances); and (4) deducing from the direct information
given, the circumstances; and the contract (any implications which may be intended) to establish what message is being presented or intended.

Drawing inferences is an involved process. There are unauthorized inferences as well as the authorized ones which have been discussed above. Authorized inferences are those which the speaker (or writer) intends for the listener (or reader) to draw. Unauthorized inferences are those which the listener draws without the speaker's authorization. In authorized inferences the listener must be aware that the speaker intends an inference to be drawn; therefore, there must be a very clear contract between the two or more involved.

Communication revolves around comprehension of which inferences play a major role. Drawing inferences requires skill that both the speaker and listener need to develop, for inferences are not thought of as "inferences" but are considered an integral part of a message and remembered as clearly and distinctly as the direct and explicit part of a message (Clark, 1977).

Semantic and Episodic Memory

Tulving (1972) identifies two memory systems, episodic and semantic. He speaks of the two systems as being separate for the convenience of clarification, rather than to stress that the two are structurally or functionally separate. Tulving (1972) describes semantic memory as the following:

Semantic memory is the memory necessary for the use of language. It is a mental thesaurus, organized knowledge a person possesses about words and other
verbal symbols, their meaning and referents, about relations among them, and rules, formulas, and algorithms for the manipulation of these symbols, concepts, and relations. Semantic memory does not register perceptible properties of inputs, but rather cognitive referents of input signals. The semantic system permits the retrieval of information that was not directly stored in it, and retrieval of information from the system leaves its contents unchanged, although any act of retrieval constitutes an input into episodic memory. The semantic system is probably much less susceptible to involuntary transformation and loss of information than the episodic system. Finally, the semantic system may be quite independent of the episodic system in recording and maintaining information since identical storage consequences may be brought about by a great variety of input signals. (p. 386)

On the other hand, episodic memory represents memory of personal experiences and their temporal relations. Episodic memory is characterized by its temporal and spatial ordering and relations among events or episodes. Episodic memory receives and stores information encoded in terms of its perceptible attributes and is always stored in regard to its autobiographical reference in the existing structure (Tulving, 1972).

Semantic memory has a larger variety of relations among its items than episodic memory. The two sources of input are perception and thought; however, perception is important only in that it permits the identification of referents to be less ambiguous. Little is known of the input source, thought, and Tulving does not speculate about its attributes (Tulving, 1972).

Semantic memory inputs are directed to a cognitive structure already in existence which stores information depicting objects,
concepts, relations, quantities, events, facts, propositions, etc., which are removed from any autobiographical reference. Information in semantic memory is learned directly or indirectly and can be stored directly, indirectly, or in parts. Inferential reasoning, generalizations, application of rules and formulae, and algorithms can retrieve information not learned directly. Episodic memory is more susceptible to interference or erasure of information than is semantic memory because information in semantic memory is encoded, and by process of accretion, is assimilated into a multi-dimensional structure which embeds concepts and their relations, establishing a system of protection of the stored information from interference or erasure. The differences between the two systems for which Tulving argues have been presented, and it has been acknowledged that the two systems often interact, but their dependence upon each other varies in consideration of the task (Tulving, 1972).

There are many theories on memory. These theories usually take the conceived notion of "memory" and divide it into smaller areas for the purpose of studying it and making the results generalizable (Tulving, 1972).

**Organization of Texts**

One of the major goals writers and/or speakers should strive to meet is that of organizing their texts such that comprehension is less of a problem. As mentioned before, if writers would become more aware of the processes involved in comprehending connected
discourse and readers and listeners would strive to increase their experiences with connected discourse and all it includes (e.g. words, concepts), learning from texts would become a much less difficult process (Deighton, 1959).

There are two general theories regarding the organization of information: schema and taxonomy. Both will be briefly introduced. Mandler (1978) mentions that each of the two theories may have different implications for remembering, which is part of the comprehension process. The mind takes the encoded stimuli and structures it in such a way as to make order by identifying regularities or consistencies. This in turn leads to future expectancies which leads a person to make predictions. Organization has two important functions: efficient encoding and retrieval. Without some sort of memory organization (structure), efficient encoding and retrieval would be impossible. In discussing the two theories, schema and taxonomy, one must realize that it is possible to have both at the same time. It is also possible to define taxonomic in terms of schematic, and vice versa. Taxonomic organizations, however, occur relatively late in mental development. Both types of activity occur every day as part of the mental processes in which one would engage (Mandler, 1978).

Mandler (1978) generally refers to categorical (taxonomic) organization as:

The cognitive structures hierarchically arranged, which govern our understanding of the relationships among superordinate, subordinate, and coordinate classes. In addition to lists of items
that belong to a given category, this kind of organization includes the more abstract knowledge of class inclusion relations, which enables both inductive and deductive thinking. (p. 5)

Categorical (taxonomic) organization is flexible in that it allows classification often through similarities and differences. However, there are many other ways of classifying, (e.g. form or function). This flexibility causes difficulty in problem solving because it lends ambiguity in the retrieval process due to the many different sets of retrieval cues possible for a single item (Mandler, 1978).

Taxonomic organization usually has no principles governing connections between categories or between items within categories. The principal connections are usually "vertical," occurring in a hierarchy as superordinate and subordinate divisions. There are many different types of relationships, including that of similarity, prototypicality of exemplars, associations, or cross-classification. This increases the difficulty of retrieval because there is usually no order of occurrence, thus no predictability. Lack of rule governed relationships is the major difference between categorical and schematic organizations; also, that of spatial or temporal ordering of items. Categorical organization has neither a particular spatial or temporal order. This also increases the difficulty of retrieval. In an expanded hierarchial structure which has principles of ordering items, however, the predictability increases. It sometimes proves difficult for subjects to identify the
organizational principles even when instructed beforehand. They usually have to search the overall structure of the list or use a self-imposed one of their own (Mandler, 1978).

Mandler defines schema to be:

A cognitive structure—an organized representation of a body of knowledge. This type of organization is not based upon class membership or relationships of similarity or difference. Instead, it is a structure which is spatially or temporarily organized on a basis of contiguities experienced in space or time. A schema is formed on the basis of past experience with objects, scenes, or events and consists of a set of (usually unconscious) expectations about what things look like and/or the order in which they occur. The parts, or units, of a schema consists of a set of variables, or slots, which can be filled, or instantiated, in any given instance by values that have greater or lesser degrees of probability of occurrence attached to them. Schemata vary greatly in their degree generality—the more general the schema, the less specified, or the less predictable are the values that may satisfy any given slot. (p. 7)

Schematic organizations also differ from taxonomic organizations to the extent with which automatic activation occurs. In schematic organizations a subject has advance knowledge of the structure of an item. For example, if one were to discuss "going to dinner," one could automatically activate the schemata for dinner, instantiating the more specific details. The specific details, for example, include exactly where and what was eaten. Going to dinner is quite predictable in format and one could probably be very specific in predicting, given certain items. Categorical organization, however, does not produce much advance knowledge concerning the overall structure of the hierarchy and one would have to search the entire structure before becoming familiar enough with the knowledge to make a
prediction based on expectations concerning the items presented in the hierarchy. Schemata have the advantage of "default processing." This occurs by way of inferential reasoning. A schema is activated and if this is a familiar schema (or experience) it is not necessary to instantiate every individual variable, by actual perception. Enacting the schema is sufficient such that the variables are assumed to have been instantiated in activating them. One is usually not aware of this process (Mandler, 1978).

The relationship of episodic and semantic memory and taxonomic and schematic organization needs to be established. Episodic memory is based upon experiences one remembers, information concerning the time and location, although the remembered information may not be accurate. As mentioned above, episodic memory is more susceptible to transformations and erasure over time. Within episodic memory is a type of schema which is somewhat different. It is not spatially organized, rather it is temporally organized. This type is event schema which are generalized representations of types of events which occur in episodes. They are a part of personal experience, but are not necessarily spatio-temporally related, nor is it important for them to be autobiographical. Events are spatially and temporally organized within the cognitive structure, but it is not important that all events be "remembered when." Generally, schematic organization is thought to be episodically based, and taxonomic organization is considered semantically based (Mandler, 1978).
Organization of cognitive structure is necessary for encoding and retrieval purposes. Generally, both types of organization are present but the more specific the level, the more pronounced the differences become in the two types of organization (Mandler, 1978).

Statement of the Problem

Little is known about the factors which affect comprehension of technical textual discourse. This study is designed to investigate this problem area.

Taxonomical and schematic organization are the two partially developed theories which provide some hypotheses that need to be tested. The problem is the comprehension of technical textual discourse. The researcher has identified several factors related to the problem: (1) organization of text similar to that of memory structure; (2) presentation of visuals for the purpose of organization of memory and text; and (3) execution of an enactive performance for the purpose of aiding comprehension in consideration of the technical aspects of the presentation. This study is designed to identify which, if any, of these factors has any effect upon the comprehension of technical textual discourse.

Objectives of the Study

In conducting this study the researcher hopes to find evidence which will enhance the understanding of technical textual discourse, as well as seek more insight as to its representation in memory. The main objectives are:

1. To compare the comprehension of schematically and taxonomically organized technical textual discourse.
2. To compare the effects of visuals vs. no visuals on the comprehension of these two types of presentation.

3. To compare the effects of enactive performance vs. no enactive performance on the comprehension of these two types of presentations.

Statement of the Research Hypotheses

The following research hypotheses are postulated:

1. The subjects receiving the schematically organized technical textual presentation will achieve significantly higher scores on the tests for initial learning than those receiving the taxonomically organized presentation.

2. The subjects receiving text coordinated visuals will achieve significantly higher scores on the tests for initial comprehension than those not receiving visuals.

3. The subjects receiving the opportunity to enactively perform the technical aspects of the presentations (taxonomic and schematic) will achieve significantly higher scores on the tests for initial learning than those not receiving the opportunity to perform the activity.

4. The students receiving the combination of Treatments A, Level 2; B, Level 1; and C, Level 1 will out-perform those not receiving this combination. Those receiving the combination of Treatments A, Level 1; B, Level 1; and C, Level 1 will out-perform those receiving A, Level 3; B, Level 2; and C, Level 2. (See Figure 4, Chapter III, for a more graphic description of the design.)
Assumptions of the Study

The following assumptions are held:

1. It is a goal of education to teach students how to acquire knowledge from oral and written discourse.

2. It is a goal of Industrial Technology Education to teach students how to acquire technical information from oral and written discourse.

3. Knowledge can be expressed in written or spoken language.

4. Readers and listeners can acquire knowledge from reading and listening.

5. Knowledge has structure.

6. Knowledge is encoded and stored in memory and retrieved from memory.

7. Memory has cognitive structure(s).

8. Knowledge has a memorial representation.

9. Schematic and taxonomic organizations are two partially developed major theories of memorial organization or structure.

10. Memory and memorial structure play a major role in comprehension.

11. Comprehension can be observed and measured by the cloze procedure and recall.

12. Students involved in the study will attempt to learn or "comprehend" the textual knowledge presented to the best of their ability and be motivated to achieve.
13. Students have no prior knowledge of the information presented, or if they do, students with such knowledge will be randomly distributed within the treatment groups.

**Delimitations of the Study**

The following delimitations (reduction of scope) were set for this study:

1. This study has been delimited to the consideration of two theories on the organization (structure) of memory and the representation of discourse within the structure.

2. The presentation was only one and one-half pages, typewritten, double-spaced (3 minutes of listening). It was essential that the presentation, enactive performance, and test be administered within the time of three class periods (3 hours) in order to obtain permission to conduct the experiment.

3. The independent variables pertaining to teaching methods were delimited to the organization of material presented, presentation of visuals, and opportunity for enactive performance.

4. Presentation of the information was delimited to listening only in the attempt to control for reading deficiencies. The presentations were accompanied by a visual in half of the presentations. An enactive performance followed half of the presentations.
5. The content of the presentation was delimited to the technological concept of casting, one aspect of forming. Other aspects were not considered due to time, space, and cost.

6. Learning measurements were delimited to two observations of initial learning or comprehension.

7. Criterion measures were delimited to three measurements, cloze verbatim, cloze idea units, and recall for idea units or proposition. The cloze instrument was used to collect two kinds of information: that of verbatim responses and idea of synonymous responses. In other words the responses on the cloze test were scored two different ways. The third measurement was collected on blank paper by way of free recall.

8. The enactive performance was delimited due to cost of materials for the number of subjects participating.

Limitations of the Study

Care must be exercised in generalizing from the conclusions based on the experimental data. This study was conducted under the following limitations (shortcomings):

1. The experiment was limited by the availability of voluntarily cooperating schools, teachers, and students.

2. The study was short-termed in nature. Instruction and measurement occurred within three class periods (3 hours).
3. The textual discourse presentation was quite brief. Care must be exercised in making generalizations because of the length of the discourse presentations.

4. The measurement was limited to that of initial learning. Retention was not measured.

5. The technical information on slip casting was very basic, such that a generalization to "all" technical textual discourse may not be appropriate or accurate.

6. There were many types of visuals. The ones used in this study were basic line drawings. Generalizations must be made carefully in view of this fact.

7. The activity was, in a sense, only partially completed. The subjects went through the actual slip casting procedure, but made it obvious that they wanted to "bake" (fire) their products. This was a disappointment to some; however, to others, it was encouragement to find somewhere to do more slip casting.
Definitions

Several specialized terms are used throughout the study. These terms are:

**Semantic structure**: "general term used to refer to any underlying representation of an utterance. The term is used instead of deep structure in some cases so as to prevent any confusion between semantic and syntactic means of analysis" (Marshall & Glock, 1976, p. 14).

**Proposition**: "the underlying semantic representation of a simple sentence as defined by case grammar (Fillmore, 1968; 1971). It is made up of at least two word concepts connected by at least one relation" (Fredericksen, 1975, p. 376).

**Word concept**: "is the underlying semantic representation of a single word" (Kintsch, 1974, p. 11).

**Relation**: "is a labeled and directed connection between any two word concepts" (Fredericksen, 1975, p. 380).

**Text base**: "is an ordered list of propositions (Kintsch, 1974, p. 15). As the word concept underlies a single word and a proposition a single sentence, the text base represents the semantic structure of a piece of connected discourse" (Fredericksen, 1975, p. 377).

**Connected discourse**: (discourse) "is the linguistic term used to define any utterance, regardless of length, that is a complete unit of meaning and has cohesion or unity (Halliday & Hasan, 1976). Connected discourse is often used as the surface structure equivalent of a text base. What one reads, then, is the connected discourse" (Marshall & Glock, 1976, p. 14).
Network: "is any set of labeled and directed relations. More specifically, it can be considered as equivalent to a tree diagram in which all the lines (relations) are labeled and indicate directionality and in which all the spaces between relations (nodes) are identified" (Marshall & Glock, 1976, p. 17).

Cohesion: "is that which binds the text into a meaningful unit. It operates upon the text base by means of reference" (Grimes, 1975).

Staging: "refers to the process of organizing the text base into a hierarchy, or outline structure so that those propositions within the text base that are superordinate are separated from those that are subordinate" (Grimes, 1975; Marshall & Glock, 1976, p. 17).

Knowledge Integration: "is the incorporation of related facts into comprehensive memory structures" (Walker & Meyer, 1980, p. 421).

Elaboration: "relates to the extra processing one does that results in additional, related, or redundant propositions the better will be memory for the material processed. Elaborations provide redundancy in memory structure. Redundancy can be viewed as a safeguard against forgetting and an aid to fast retrieval" (Reder, 1980, p. 6).

Inference: refers to the meaning a speaker or writer intends a listener or reader to draw, which is not explicitly stated (Clark, 1977).

Referent: refers to objects, events, and states of affairs one refers to in speaking or writing (Clark, 1977).

Memory Structure: refers to "organization of items in memory" (Mandler, 1978, p. 2).
Taxonomic (Categorical) Organization: "refers to the cognitive structures, hierarchically arranged, which govern our understanding of the relationships among superordinates, subordinates, and coordinate classes. This kind of organization includes the more abstract knowledge of class inclusion relations, which enables both inductive and deductive thinking" (Mandler, 1978, p. 5).

Schematic Organization: "is a spatial and or temporally organized structure in which the parts are connected on the basis of contiguities that have been experienced in space or time. A schema is formed on the basis of past experience with objects, scenes, or events and consists of a set of (usually unconscious) expectations about what things look like and/or the order in which they occur" (Mandler, 1978, p. 7).

Episodic Memory: "refers to autobiographical, spatio-temporally dated experiences. An episodic memory is one which one personally remembers and has some information as to time and location (not necessarily veridical)" (Mandler, 1978, p. 15).

Semantic Memory: "most often refers to memory for lexical knowledge or categorical knowledge" (Mandler, 1978, p. 16). A person's store of conceptual knowledge (Fredericksen, 1975, p. 371).

Encoding: "the process of analyzing the information and extracting the essential features for memory" (Ellis et al., 1979, p. 4).

Storage: "the process in memory of holding a representation of information" (Ellis et al., 1979, p. 4).
Retrieval: refers to searching memory for information in storage and then recalling it (Ellis et al., 1979, p. 4).

World Knowledge: past experiences represented within memory which the receiver of information brings with him.

Syntax: "surface structure of sentences perceived as words and phrases" (Sachs, 1967, p. 437).

Comprehension: "(understanding) a process whereby a listener or reader attempts to infer the knowledge structure of a speaker or writer by using the available linguistic message, contextual information and his own knowledge store as 'data structures' from which the inference is to be made" (Fredericksen, 1975, p. 371).

Semantic Structure: "consists of propositions which are represented as networks of concepts connected by labeled binary relations, and which identify events or states" (Fredericksen, 1975, p. 372).

Logical Structures: "consists of networks of propositions which are connected by various labeled logical casual, and algebraic relations" (Fredericksen, 1975, p. 372).

Semantic Network: "a concatenation of labeled binary relations which connect semantic 'concepts'" (Fredericksen, 1975, p. 374).

Context: "the part of a written or spoken statement in which a word or passage at issue occurs; that which leads up to and follows and often specifies the meaning of a particular expression. The circumstances in which a particular event occurs; a situation" (The American Heritage Dictionary of the English Language, 1970, p. 288).
Summary

Within Chapter I the researcher has described the nature and significance of the study, as well as stated the problem and its various elements. This chapter also includes a list of the research hypotheses and a defined list of terms. Finally, the assumptions, delimitations, and limitations upon which the study was based were given.

Chapter II will present a literature review pertinent to the study. The chapter is categorized into seven sections: (1) Discourse Comprehension, (2) Taxonomic Organization and Semantic Memory, (3) Schematic Organization and Episodic Memory, (4) The Iconic Mode of Learning, (5) The Enactive Mode of Learning, (6) Taxonomy vs. Schema, and (7) Summary.
CHAPTER II

REVIEW OF LITERATURE

This chapter presents a selected overview of literature that relates to comprehension, episodic and semantic memory, and the schematic and taxonomic theories of memory structure. The information gathered for this review has been obtained from a number of sources. A computerized system was used to search ERIC, as well as Dissertation Abstracts International, Psychological Abstracts, and Education Index. Jean Mandler's 1978 bibliography was an extremely important source for this review. The bibliography lists Dr. Victor M. Rentel used for classes in reading and testing also were of significance. Numerous articles were retrieved from Reading Research Quarterly, American Educational Research Journal, Cognitive Psychology, Verbal Learning and Verbal Behavior, Review of Educational Research, and Discourse Processes. In addition, there were many other pertinent sources, and the researcher would like to make clear that it was impossible to exhaust the literature on comprehension and memory, however, this review serves adequately to support the study, and show generally what is available in the mass of related literature.

This chapter is organized into seven sections of review. The first section discusses information processing. The second section discusses various facets of discourse comprehension. The third section describes
discourse organization and memory structure. The fourth section reviews literature pertinent to visuals and their effect on learning. The fifth section reviews literature relevant to activity and its effect on initial learning. The sixth section discusses Rabinowitz and Mandler's study on memory as it relates to the present study. Finally, the seventh section summarizes the review.

**Information Processing**

Various kinds of information processing models have been developed. In determining the type of model, one must consider the manner in which a processor applies knowledge previously stored and/or prior expectations.

There are bottom-up models. This type model is based upon an analysis of letters, words, phrases, or sentences (Chomsky, 1964; Clark & Clark, 1977; Woods, 1978; and Beaugrande, 1978).

Top-down models are based upon integrative hypotheses. The processor draws from world knowledge and experience to fill in materials for understanding. Many of these models seem to be based upon general expectations or schemata (Bartlett, 1932). Schemata are abstract outlines which are filled in during the learning process and/or combined in new ways (Schank, 1975). They evolve when new experiences occur and range from very general to specific in nature (Meyer, 1977; Fredericksen, 1977; Schank, 1975; and Rumelhart, 1975).

For this study, Kintsch's (1974) theory regarding propositions was used to analyze the technical discourse employed into underlying
propositions. Kintsch (1974) discussed the comprehension of text at several levels, but concerned himself mainly with idea level or text base, rather than the linguistic level. Psychological processes of comprehension may occur at either of these levels; however, this study was related to the processing of propositions and idea units as comprehension. Kintsch presented a theory for representation of meaning in which word concept, proposition, and text base were the major theoretical concepts. Word concepts in his view are lexical entries expressed with a single word and are joined together by rules to form propositions which are n-tuples of word concepts, one of which serves as a predicator and the others as arguments. A text base is an ordered list of propositions. Thus, one could think of a proposition as an underlying idea unit rather than the traditional sentence or statement. There can be any number of propositions contained within one single sentence or statement (Kintsch, 1974).

Kintsch and Keenan (1973) found that the processing time per proposition depended upon the length of the text being read. For brief sentences the reading time was one second reading time per proposition, while the 50-word paragraphs, about three times as much processing time was required per proposition. They suggested that as the length of the text increases, each proposition must be related to more and more others in the text. It may be possible that material which was actually processed by subjects was forgotten before they could actually construct a verbal response. Finally, Kintsch recognized that the type of proposition as well as the structural relations among propositions must also be considered (Kintsch, 1973).
Kintsch et al. (1975) controlled the number of words and number of propositions in short English texts, but the number of word concepts in the text base differed (many vs. few). These texts were read and recalled immediately. For texts with many different kinds of word concepts, the reading times were longer and fewer propositions were recalled. They also found that superordinate propositions were recalled better than subordinate propositions and were forgotten less when recall was delayed (Waters, 1978). Increasing the probability of the recall of any word concept was the function of both number of repetitions of the concept in the text base, and the number of repetitions of the corresponding word in the text. The same results were acquired when listening as well (Kintsch et al., 1975).

Kintsch's model (1974, 1980) has the most potential for the present research because of its breadth. He worked with texts rather than sentences, and moved away from classical experimental verbal learning procedures while using more refined techniques of measurement. He based his model on linguistic components. In other words, the concept of processing involves propositional units. Kintsch makes the assumption that knowledge is not only encoded and retrieved in the form of propositions, but that it is represented in memory (storage) as propositions. This claim may not be valid. It may be that propositions are merely the basic forms of expression or the basic units which result from the abstraction process before encoding. Thus, one must carefully consider this before fully accepting Kintsch's model.
Discourse Comprehension

Learning from texts is a complicated process. Consideration must be given to the complexity of the text as well as the difficulty of analyzing the behavior which reveals what is learned from textual presentations. Retrieval processes often determine what is recalled, and individual differences affect comprehension (McConkie, 1977).

Measurement is one of the more difficult aspects of comprehension. Comprehension is an abstract concept; therefore, one can never be sure of the assessment obtained from an observation. Several techniques for measuring have been surveyed and no single technique has been found to be completely reliable and universally valid. Many factors contribute to the success or failure of the measurement of language comprehension (e.g. guessing inference, memory, reliance on prior knowledge). Thus, in studying language comprehension, researchers must vary message characteristics and control temporal factors as well as instruction to subjects. Another type of problem to be seriously considered is that of text length. Little context is available when single sentences are presented; thus, comprehension of longer texts needs to be studied and researchers must explicate contextual elements or at least vary them experimentally (Carroll, 1971).

Some of the problems of studying comprehension arise from the role played by knowledge integration and inference. Often new knowledge is arrived at from a new combination of previously acquired knowledge or a new association between new and old knowledge. A major
part of knowledge integration is inference. Integration occurs among integrated facts as well as among unrelated facts. However, incoming knowledge may also interfere with the integration of inference (Reder & Anderson, 1980). Integration appears to be facilitated by proximity of related facts and by identical wordings of common case forms in related facts. Integrated memory representations may also obscure the identities of the original integral facts (Hayes-Roth & Thorndyke, 1979).

A major part of studying comprehension involves learning how knowledge was integrated. Information higher in text structure was more likely to be integrated than information lower in text (Walker & Meyer, 1980). Facts which occurred together in text aided faster correct decisions than those which occurred separately. Thus, structural integration was more apt to occur when facts occurred together than when they were separate (Walker & Meyer, 1980). Reading time was also affected by the distance between items. Carroll and Sanford (1977) found that information was integrated at the time of reading rather than retrieval.

Inferences are integral parts of what is comprehended. Subjects appear not to consider implicit information inference at all; rather they process it just as they do explicit information indicating that implicit information is integrated just like explicit information (Clark, 1977; Hildyard & Olson, 1978). Much of the information in texts as well as oral discourse is implicit. In order to aid comprehension, it would seem that students must: (1) be taught to automatically infer implicit information, (2) isolate aspects of the texts that seem
important and elaborate at the expense of less important aspects, and (3) have sufficient knowledge of concepts referred to so that they may infer and elaborate upon input. Appropriately-asked questions did aid comprehension and influence memory as well as prior knowledge, inherent interest, and instructions (Reder, 1980).

Text structure affects comprehension and recall. Manipulating the text structure, as well as if-then relations, adjectives, main ideas, and designating clauses, enhanced comprehension (Marshall & Glock, 1978). Two levels of text structure have been studied. Macro-level (global) and micro-level (local) portions of the overall structure seem to rely on the different cognitive resources (Lesgold et al., 1979; Vipond, 1980). Sentences on a higher level take longer to read than those on a lower level. Early-occurring sentences also take longer than those occurring later. Thus, it seems that structural assignment has an effect on comprehension (Meyer, 1980; Cirilo & Foss, 1980).

Research on learning from text has become much more difficult. A new discipline called cognitive science is slowly developing. This would allow people from several disciplines to study language processing and learning in man and machine. These concerns have previously been the concerns of educational psychologists. Linguists and computer scientists have stimulated the new direction; however, there is now a need for empirical, descriptive studies which will lend insight as to how people learn and retrieve information from text, facts which will constrain what may be taken as acceptable theories (McConkie, 1977).
Mandler (1978) claims that two memorial structures exist: taxonomic and schematic. Research on comprehension began by focusing on taxonomic organization or verbal learning. A new focus for memory research is based on memory for stories and pictures. The emphasis centers around schematic organization or episodic structure.

Industrial arts has both taxonomic and schematic information inherent within its subject matter content. The verbal nouns around which the concepts (content) of the field are organized are semantic in nature, yet the "doing" content has a definite episodic nature. Mandler (1978) clearly emphasized the fact that taxonomic organization occurs within a person as a result of schooling. She indicated that episodic organization was a more natural occurrence within a person and begins at the youngest ages and is maintained throughout adulthood.

Industrial arts content seems to be conducive to studying both structures as well as determining which one, if either, should be used to structure or organize technical discourse. If, in fact, memory has a taxonomic and episodic structure, it would seem rational to identify the taxonomic content as well as the episodic content within the field and then to organize the text and oral discourse to reflect this structure. Thus, the information to be encoded would already have similar structure to that of memory and the processes of encoding, storage, and retrieval would become simplified. In other words, the organization of instructional discourse could facilitate the representation of knowledge in memory, in turn aiding comprehension.
Mandler defines taxonomic organization as:

In general, categorical or taxonomic organization refers to the cognitive structures, hierarchically arranged, which govern our understanding of the relationships among superordinate, subordinate, and coordinate classes. In addition to lists of items that belong to a given category, this kind of organization includes the more abstract knowledge of class inclusion relations, which enables both inductive and deductive thinking. (Mandler, 1978, p. 5)

Young children categorize in simplified ways. Two year olds are responsive to taxonomic organization in memory tasks. They also categorize pictures. By the age of three, children show release from proactive inhibition whenever they are introduced to a new category in memory tasks. However, in remembering tasks, there is a great difference between the use of schemata and taxonomies. Third grade children show very little clustering response when recalling categorized lists given the organization. This is not due to lack of knowledge of categories. Thus, presentation of a list does not seem to activate this type of organization (Mandler, 1978). However, category organization in recall seems to increase with grade level (Kobasigawa & Middleton, 1972).

When children do sort items, their recalls become clustered just as adults do, but children stop the within category searches before adults do. Children seem to have smaller categories than adults. If a taxonomic organization was familiar to second graders, it produced clustering in recall, but if a list consisted of unrelated items,
then the organization was not evident in recall. Children who use new organization for retrieval must have been active beforehand in the decision-making about what goes with what (Mandler, 1978).

Mandler makes the assumptions that: (1) categorizing is not spontaneous in children in organizing their world and (2) that it is only a result of memorizing strategies. It seems effective for adults as mnemonic strategy; however, they impose it upon themselves. Even when adults expect no recall tests, clustering in categories occurs. It seems that clustering by categories occurs to a higher degree the older the person. There are times, however, when adults do not use categorical organization. Thus, it seems that young children do not discover categorical structure, and this lack of discovery happens less often in adults. It is theorized that neither children nor adults ignore schematic structure or fail to use this structure when retrieval occurs concerning scripts, stories, and events. Seemingly children have a lesser tendency to search for ways of organizing superficially, whether memorizing or not. These organizations may not be necessary for retrieval. Taxonomic organization seems to be a more recent acquisition for them than schematic organization.

Children have very little hierarchical structure mentally while young. Concepts are episodically organized by schemata. Only gradually are they regrouped hierarchically. Even adult knowledge tends to remain organized around the schematic prototypes of childhood. Therefore, it seems that taxonomic structures are slowly developed methods of organization. Taxonomic structures seem to be an addition to a schematically
organized knowledge base. And, it seems clear that adults use schematic organization in daily negotiations and for daily retrievals. Cross cultural data suggest that the emphasis on categorical organization in memory research is misplaced given these findings about episodic memory (Mandler, 1978).

In studies among the Vai and Kpelle of Liberia it was generally concluded by Mandler (1978) that there was little use of taxonomic organization among those with little schooling. And with the same schooling activities of Americans, the effective use of taxonomic organization improved. These studies also provided support for improved recall if materials were embedded in story contexts. Therefore, Mandler (1978) makes the assumption that schematic organization is the main structure of memory and that story formats are universal, regardless of the culture. This must be true because stories told orally must have respect for the limitations of memory. Mandler et al. (1978) found that patterns of recall of stories are approximately the same across ages, literacy, and culture. This suggests that schematically-based retrieval should also be universal. In conclusion, one could contend that schooling adds context-free schematic structure. Therefore, new ways of organization do not replace schematic ones, merely add to them (Mandler, 1978).

Semantic memory is the memory necessary for the use of language. It is a mental Thesaurus, organized knowledge a person possesses about words and other verbal symbols, their meaning and referents, about relations among them, and rules formuales, and algorithms for the manipulation of these symbols, concepts, and relations. Semantic memory does not register perceptible properties of inputs, but rather cognitive
referents of input signals. The semantic system permits the retrieval of information that was not directly stored in it, and retrieval of information from the system leaves its contents unchanged, although any act of retrieval constitutes an input into episodic memory. The semantic system is probably much less susceptible to involuntary transformation and loss of information than the episodic system. Finally, the semantic system may be quite independent of the episodic system in recording and maintaining information since identical storage consequences may be brought about by a great variety of input signals. (Tulving, 1972, p. 386)

There is much research that supports the concept of a semantic memory taxonomically organized. The work between 1932 and the early 1970's was limited to studies of memory for nonsense syllables, words, phrases, and sentences. The research revealed the nature of semantic memory; however, it did not disclose the true nature of discourse comprehension and/or the psychological processes involved. Studying nonsense syllables, words, phrases, and sentences was not realistic because people rarely, if ever, read lists and try to recall them. Therefore, realism lies in studying comprehension of discourse.

Semantic memory seems to be organized into natural categories which are fuzzy rather than well defined (McCoskey & Glucksberg, 1979). The system stores generalized information by way of superset nodes, rather than individual nodes to which generalizations can be made (Collins & Quillian, 1969). Merris and Pani (1980) considered two examples of best-example theory for category acquisition. The results supported the examples. These were: (1) "That categories which people acquire based on initial exposure to good examples should be learned more easily and (at first) more accurately than categories based on initial exposure to poor exemplars; (2) . . . that people should
generally learn that the best exemplars are category members, before learning that the poor exemplars are category members" (p. 446). This implied that people generalize based on similarity, and that the better the example, the more maximal the within-category similarity. This implies that people generalize based on similarity, and that the better the example, the more maximal the within-category similarity. It seems that the most inclusive categories by which a concrete image of the category as a whole can be formed are basic objects, and that basic objects are also shown to be the first categorization made while perceiving the environment. Basic objects are shown to be the earliest children sort and name, and they tend to be the most codable, coded, and necessary categories (Rosch et al., 1976). Children also seem, more often than not, to reveal the first and last objects seen (Goldberg et al., 1974).

In recalling words, the use of category names as retrieval cues seemed to increase recall (Tulving & Pearlstone, 1966; Slameka, 1972). This was interpreted to mean that intact memory traces of words not recalled under non-cue conditions were available in storage, but not for retrieval. There seemed to be at least two basic kinds of information concerning semantic categories stored in memory, names of categories they intersect and representations of their attributes (Meyer, 1970). Thus, it has been suggested that intersecting category names which are stored are organized in a network which is based on category overlaps. Therefore, the organization of semantic memory may very well determine when and what can be retrieved. This could certainly
have great implications for comprehension. If discourse were organized such that it conformed to the structure of semantic memory, then one could hypothesize that retrieval may be facilitated by such an instructional strategy.

Another characteristic of categorical organization is that learning and identification reaction time is affected by family resemblance within categories, and lack of overlap of elements with contrasting categories. Researchers have argued that categories were defined by family resemblance (Rosch & Merris, 1975; Rosch et al., 1976). Words are processed in terms of their semantic characteristics even when positioned above and below the target word. Therefore, "the number of word categories (chunks) represented in a list of 20 categories of words should be the same as the number of words recalled from a list of 20 unrelated words" (Shaffer & LeBerge, 1979, p. 233). It is feasible that subjects with high amounts of categorical clustering recalled more words than subjects with a lower amount of clustering (Puff, 1970).

Reaction time seemed to be affected by category size. Memory was searched much like a computer program. After searching a number of levels, if no path was confirmed the response was false. People checked out obvious connections even when it violated the syntax of the sentence (Collins & Quillian, 1972). Inter-response time was different for within a conceptual category and between categories (Patterson et al., 1971).

Recall and recognition seemed to be affected by number of categories, size of categories, and the organization of the lists (Mandler,
1969; Bonser et al., 1969; Broadbent et al., 1978). Subjects given organized presentations recalled 2-3 times better than those who received random organization. Organization also served as a retrieval plan for cueing recall (Bonser et al., 1969). Organization also decreased input processing time (Kellas et al., 1973). In the examination of temporal aspects of storage and retrieval, the same data supported the presence of a category exit component for retrieving higher-order memory units. This supported retrieval based on trace strength.

As noted before, the characteristics of semantic memory seem to be taxonomic, a viable organization for certain categories of cognitive information; however, a taxonomic description of memory does not lend itself to spatial and temporal information. Much of everyday life is episodic in nature, as it much of the technical content of industrial arts.

Schematic Organization and Episodic Memory

Mandler (1978) defines and describes schematic organization as:

A cognitive structure—an organized representation of a body of knowledge. This type of organization is not based upon class membership or relationships of similarity or difference. Instead, it is a structure which is spatially or temporally organized on a basis of contiguities experienced in space or time. A schema is formed on the basis of past
experience with objects, scenes, or events and consists of a set of (usually unconscious) expectations about what things look like and/or the order in which they occur. The parts, or units, of a schema consist of a set of variables, or slots which can be filled, or instantiated, in any given instance by values that have greater or lesser degrees of probability of occurrence attached to them. Schemata vary greatly in their degree—the more general the schema, the less specified, or the less predictable are the values that may satisfy any given slot. (p. 7)

Mandler (1978) concentrates on two broad classes of schemata; scene schemata and event schemata. Scene schemata as a class are expectations of what one would expect to see in "given" situations. In other words, a scene schema is a cognitive representation of these expectations. The variables of which scene schemata consist are of different categories, e.g. furniture, buildings, plants, people, towns, etc. The degree of generality can vary. A room schema is one of the more general schemata. It has variables (defining features) which are obligatory that have to be filled; however, it has a broad range of choices with which to use in filling. A room has to have walls, a floor, and ceiling to be a room; however, any arrangement is possible. It is expected to have furniture, but the range of values is immeasurable, or it could be empty. Once one determines a specific kind of schema, it becomes less general, and there is a narrower range of values with which to fill the variable slots. For example, a kitchen schema has a narrower range of furniture, etc., that can fill the variable slots than a room schema. And, to go a step further, if one were to acknowledge a country kitchen rather than a modern kitchen, one can see
how the range of variables becomes even narrower. Therefore, the stronger one's expectations are for certain aspects of a schema to occur, the more defining the values are said to be. There is an important point to be made concerning some schemata. The class consists of expectations based on normality and one's knowledge about a particular concept. The set of expectations are often limited rather than everything one knows about a concept.

Also, scenes have spatial expectations. For example, one's knowledge about the location of objects within a scene is considered to be part of the definition and description of scene schemata, and the same kind of considerations apply to spatial organization of a scene (Mandler, 1978).

Scene schemata have been studied through pictures (scenes). Complex pictures were used to study real-world schemata. Scene schemata consist of inventories of objects in a scene and their locations related to each other; however, it does not seem that scene schemata include descriptive information about objects' appearance on scenes' overall spatial location. Thus, real-world schemata did not seem to have an effect on the encoding of various types of descriptive information, but they did seem to have an established role in encoding and memory for spatial information. Children were poor at processing spatial information from unorganized pictures. They had developed scene schemata and used them to encode and retrieve organized scenes. They had difficulty organizing materials structured in unfamiliar ways (Mandler & Johnson, 1976; Mandler & Ritchey, 1977; Mandler & Parker, 1976; and Mandler & Robinson, 1977).
Another aspect is that action schemata seemed to guide the formation of episodic representation. High-level items relevant to the theme of the action schema were represented in a prototypical form which was closely connected to the action theme. The low-level items relevant to the theme were detailed, but their representation was not connected to the action-theme. Action schemata seemed to be active both as a recall and recognition agent within the retrieval framework in identifying an item in the scene, but not for figurative detail (Goodman, 1980; Bower et al., 1979).

Event schemata as a class involve a shift in focus from spatial to temporal organization. And events are being considered rather than scenes or physical objects which are usually the focus of taxonomical organizations. Events can be categorized, but are not usually in memorial experiments. Most categorical memory research is centered around nouns rather than abstract verbs. "Event schemata are temporally organized representations of common sequences of events. They may also be described as hierarchically arranged sets of expectations about what will occur in a given situation" (Mandler, 1978, p. 11). Similar to scene schemata, variables have embedded descriptions which narrow as the level of detail increases. And, the degree of generality can vary. Schank and Abelson (1975, 1977) have labeled concrete schemata "scripts". An example of a script would describe a sequence of events which equal, in total, going for a meal at a restaurant. A more general event schema has been labeled by Schank and Abelson (1975, 1977) as "plan". Plans have very broad sets of
expectations which are organized around a person's world knowledge and daily behavior sequences. The range of values for plans are also broader. Plans have not been researched in detail. However, a good deal of work has been done with a type of event schema, story schema. A story schema is an expectation which specifies the form and event sequences with stories. However, the variables are open for various types of content. In other words, stories can be very different, e.g. "The Three Little Pigs and Star Wars", but the structured format is quite similar.

Scripts and story schemata also have a hierarchial structure much like that of a taxonomy, but there are constraints on the number of units at one certain level. Subjects recalled facts in the upper level better than those in the lower lever (Thorndyke, 1977; Bower, 1979). There are decision-making points within event schemata; however, once a path begins, it runs in a determined way. Sometimes the temporal sequence is determined causally. For example in going to a restaurant one has to order before eating. Schematic structures differ from taxonomic ones in another sense as well, they are automatically activated. In other words, schematic organization provides advance knowledge as the structure and expectations are used to encode in a highly detailed way (Bartlett, 1932; Bower, 1976; Habertandt et al., 1980). Rumelhart and Ortony (1977) maintain that comprehension consists of selected sets of schemata which bind variables to presented stimuli. This is inferential and takes time. When activating a schema one does not necessarily instantiate every variable; the schema itself fills in
the details. This is called default processing and is considered to be the inferential aspect of perception. In other words a schema automatically fills in details not seen. It sometimes fills in details which, in fact, did not occur.

Stories have been the foundation for much of the research related to the schema theory. Children and adults are sensitive to story structure (Mandler & Johnson, 1977). Retrieval, however, may be dependent on a different schema than the one in action at the time of encoding.

Story recall was affected by the length of the episode(s), and adding actions did not affect recall of the original episodes; however, they were not rated as important as the original ones (Black & Bower, 1979). The length of the story also affected recall of the statements, but did not in any way affect organization. It remained standard (Glen, 1978).

The episodic story structure remained equivalent within movies. The recall protocols of subjects receiving movie presentations were very similar to story recall protocols. Memory did not seem to be dependent on the surface form of the story.

Schemata are the "building blocks of cognition" (Rumelhart, 1975, p. 2).

Schemata are data structures for representing the generic concepts stored in memory. There are, we believe, at least four essential characteristics of schemata which combine to make them powerful for representing knowledge in memory. These are: (1) schemata have variables; (2) schemata can embed one within the other; (3) schemata represent generic concepts which, taken all together, vary in their levels of abstraction; and

The framework which schemata provide, along with allied concepts, form a basis for a theory of human information processing. Therefore, schema is a theory about knowledge representation and the facilitation of that knowledge. It is a data structure which represents all generic concepts in memory, and also includes the network of inter-relations which holds the parts of the concepts together. A schema which underlies a concept corresponds to the meaning of that particular concept, and the meaning is encoded into memory in the terms of situations or events, which in turn instantiate that concept (Rumelhart, 1975; Rumelhart & Ortony, 1977; Shank & Abelson, 1977). Schemata are sometimes called substructures in the sense that they are collections of concepts and associations that occur together, often repeatedly. They act as unitary, higher-order concepts and associations from schema to other concepts usually specifying detailed information for a particular context. Schemata structures facilitate encoding as well as storage and retrieval (Thorndyke & Hayes-Roth, 1979).

Instantiation of a schema is similar to the enactment of a play; whenever an arrangement of values are tied to a group of variables at a certain moment in time, a schema could be said to have been instantiated. One interprets a situation as an instance of a particular concept, and then instantiates the appropriate schema by association of schema variables with the aspects of the situation (Rumelhart, 1978). Their results have suggested that the term which named the expected
instantiation of a general term better cued the recall of a sentence, rather than the general term even though it was not the term which had appeared in the sentence. Thus, this could not occur if people encode the meanings of general terms (Anderson et al., 1976).

Learning within the theoretical framework established by the schema theory occurs in three basic ways: (1) restructuring, (2) tuning, and (3) accretion. Learning by way of accretion is the normal day to day style of learning; it is the daily accumulation of knowledge which happens to most of us. This means that the daily memories of the day's events merely involves an accumulation of information in memory. Learning through tuning is a more significant type of learning, and because the process involves changing the categories used for interpretation of new information tuning is not simply an addition to our data base. The set of categories (schemata) of interpretation undergo continuous tuning. In other words, our schemata undergo modification to bring them in congruence with the demands placed upon them to function. The most difficult type of learning, and the most significant, is that of restructuring, which occurs when one has to create a new structure for the purpose of interpreting new information or imposing new organization for information already in storage. Once a new structure is established, new interpretations of knowledge, different accessibility to that knowledge, changes in interpretations, and therefore the acquisition of new knowledge can occur. Restructuring takes much time, effort, and previous accumulation of a mass of information to occur, and it is partially the need to organize this mass
of accumulated information which lends to the need for restructuring (Rumelhart & Norman, 1978).

Readers and listeners often envoke schemata in the processing of information. Text which had author-imposed textual schema had a higher recall if the readers made use of the author's schema. Recall was poor, however, if they did not use the schema (Meyer, 1978).

The encoding and retrieval processes for stories seemed to be independent. When told to shift perspectives after the first recall, the subjects envoke a different schema which allowed the use of different categories of information (Anderson & Pichert, 1977).

People tended to interpret passages in terms of their background. Ambiguous passage interpretations varied according to a person's background. Thus, it seemed high-level schemata provided interpretative framework for comprehension (Anderson et al., 1977).

Children develop schematic structure and elaborate it over time (Waters, 1980). In the event of gaps caused by forgetting, people bridged the gaps by inventing material (Gauld, 1967). Thus, if cognitive states were different when remembering errors were made. There seemed to be few errors if the cognitive state was the same at recall as it was at the time of encoding (Spiro, 1980).

Readers and listeners tend to abstract material for the purpose of acquiring a relevant interpretation based upon their own schemata (Tierney et al., 1978). People also integrate information from sentences which were not consecutive, but semantically related (Bransford & Franks, 1971).
Thorndyke and Yekovich (1979) detailed the strengths and weaknesses of the schema theory as related to a theory of human memory. Their evaluative criteria consisted of: (1) plausibility, (2) description, (3) prediction, and (4) testability.

The requirement of plausibility means that the schema theory "must provide plausible mechanisms for the representation of knowledge structures associated with narrative discourse and the use of those structures during text processing" (p. 32). Schema theory meets this requirement, and is buttressed by its similarity to phenomenological experience. The idea that familiarity with stereotypic narrative relationships facilitates comprehension is very appealing, and has a strong historical basis. For almost 200 years, the idea of schemata has been a construct for interpreting behavioral phenomena.

Description, as an evaluative criterion, means that a theory should have a very clear framework conceptually, and a lexicon for the purpose of explaining behavioral phenomena. The theory must also be highly distinguishable from alternative theories, and must either explain observations previously unexplainable, or explain them more parsimoniously than the alternatives. The schema theory strongly does this, for it has both a vocabulary and conceptual framework for representing knowledge. It allows for a structural analysis of texts not previously established because of its prototypical patterns of abstract narrative elements. This made it possible to move from studying mere sentences to discourse and memory, and finally it provides explanation for behavioral phenomena when people read and recall texts.
Prediction is the third evaluative criterion established by Thorndyke and Yekovich. This means that the theory be capable of providing non-trivial predictions about potential observations. In other words, it has to be able to assert about unobserved behavior. For a schema theory this means the theory must account for detailed assumptions of both memory structures which encode knowledge and the processes that operate the structures (schemata) during activation and instantiation. This theory falls short on prediction, and is too general. It only vaguely specifies that it may be able to explain after the fact any set of data, and is difficult to find data inconsistent with it. Schema theory has been used primarily to account for existing data, but is not specific enough to use predictively. For example, if a constituent detail in a set of information did not fit the involved schema, it is not clear what the theory would predict about memory for that data. Very few detailed process mechanisms have been developed or tested empirically as related to the schema theory. Thus, the absence of these process constraints gives the theory little predictive power (Thorndyke & Yekovich, 1979).

The fourth and final evaluative criterion is that of testability, which means that a theory has to be subjected to empirical tests of its predictions. The theory must be vulnerable to discontinuing data, which means that the more specific or constrained the theory, the more vulnerable it becomes. The more vulnerable a theory becomes, fewer observations confirm it; therefore, the most preferred theories are those which are highly vulnerable and capable of making the most
specific predictions. These theories can then accommodate obtained data or alternative outcomes. Thus, schema theory is unable to meet the testability criterion. Because of a lack in two areas: that of "(1) specification of the domain of knowledge for which schemata exist and are used and (2) specification of the detailed processes that operate on and utilize schema" (Thorndyke & Yekovich, 1979, p. 36). Currently, it is not clear as to how detailed schemata can be, as well as how many occurrences of an event are required to confirm a schema for a particular event. Another weakness is that of the manipulation or instantiation of schemata. Because of the absence of process dynamics, one can not realistically predict situations where schemata are invoked and used. "Does repetitious use of a schema facilitate or interfere with its effectiveness as a memory organizer?" (p. 37). Schema theory falls short of the expectations of a scientific theory, seemingly due to incompleteness rather than inaccuracy, and this may be because of its stage in the process of theory development. As the theory grows, the number of constraints and assumptions increase also, and as more constraints are imposed, the possible testable predictions increase as well as the theoretical power. When the specificity increases, fewer potential empirical observations remain consistent.

Episodic memory in contrast to semantic memory, appears to more accurately mirror the imperfections of memory functioning and, in certain respects, gives a better account of how memory actually operates (Mandler, 1978).

Tulving defines and describes episodic memory as:
Episodic memory receives and stores information about temporally dated episodes or events, and temporal-spatial relations among these events. A perceptual event can be stored in the episodic system solely in terms of its perceptible properties or attributes, and it is always stored in terms of its autobiographical reference to the already existing contents of the episodic memory store. The act of retrieval of information from the episodic memory store, in addition to making the retrieved contents accessible to inspection, also serves as a special type of input into episodic memory and thus changes the contents of the episodic memory store. The system is probably quite susceptible to the transformation and loss of information. While the specific form in which perceptual input is registered into the episodic memory can at times be strongly influenced by information in semantic memory—we refer to the phenomenon as encoding—it is also possible for the episodic system to operate relatively independently of the semantic system. (Tulving, 1972, p. 385-386)

Episodic memory is sometimes inaccurate as to time and location. Items within a schema are spatially, temporally, and/or causally connected, rather than logically connected as in categorical arrangements. Due to these connections within a schema, there is a tighter integration of schematic organizations. The units are highly specific and limited in number. This relates to event schemata more than scene schemata, and, as mentioned before, the processing of schemata within episodic memory is automatic, which involves a large degree of inferencing to fill in the details or variables (Mandler, 1978).

In summary schema theory is more realistic in consideration of the daily encounters with discourse, events, and scenes which are episodic in nature. Schema theory is applicable to the study of
natural settings and episodically organized discourse characteristic of industrial arts, as well as more normal types of encounters with the psychological processes involved in daily comprehension. Comprehension thus can be studied with greater subtlety and delicacy within the framework established by schema theory.

The Iconic Mode of Learning

Learning is heavily dependent upon spoken or written instructional communication. It is well known and acknowledged that misinterpretations are constantly encountered because of ambiguities inherent in communication and differences in pupils' background and knowledge (experiences). Students seldom share identical experiences; thus, it is impossible for them to possess identical meanings for symbolic referents. The lecture is the main vehicle for the transmission of knowledge in formal schooling. There seems to be, however, significant differences in the amount of information acquired by those exposed to visual symbols as well as lecture. Learning begins with concrete, and continues with the abstract (see Figure 1) (Dwyer, 1978; Dale, 1974).

In using visuals, teachers have tried to alleviate the need for concrete personal experience. This strategy of integrating visuals has been used with the intention to enhance learning by illustrating relevant content information to complement both oral and printed instruction.
Figure 1
Cone of Experience (Dale, 1969)
One must understand, however, that people have to have in their background sufficient experience and maturity to realize that visuals are a mere attempt to represent reality. This is an alternative to direct concrete experience. One must also realize that there are various types of visuals, and it has not been determined which is the best for a particular situation. There is a shortage of research relevant to the use and effects of visuals, as well as the problem of knowing when visuals have an adverse effect on learning. For example, illustrations which have too much or too little instructional stimuli have a negative effect on learning, but research has not determined when this occurs. Another factor to consider when using visuals is that of exposure time. How long does one present visuals for viewing? It is possible to have a visual that teaches by way of a long interaction, or one that teaches by a short scanned interaction (Dwyer, 1978).

Finn (1953) and Dale (1974) agreed that there existed a concrete-to-abstract dimension of learning, and that the great probability of visuals increasing learning lies in its potential as a realistic or lifelike stimulus. Dwyer (1978) presented a figure on the effects of visualization which summarized how much information was learned through the senses and remembered (see Figure 2). One cannot assume that the use of visualization facilitates learning without discriminating about the students, the situation, and the visual employed (Dwyer, 1978) (see Figure 3).
WE LEARN:

1% Through Taste
1½% Through Touch
3½% Through Smell
11% Through Hearing
83% Through Sight

Figure 2
Learning Through the Senses

PEOPLE GENERALLY REMEMBER

10% Of What They Read
20% Of What They Hear
30% Of What They See
50% Of What They See and Hear
70% Of What They Say As They Talk
90% Of What They Say As They Do A Thing!

Figure 3
How We Remember

(Dwyer, 1978)

There are basically two ways of presenting visuals for instructional purposes. Externally paced visuals are those such as film, television, and transparencies with which students usually receive grouped instruction. Self-paced visuals, on the other hand, are those such as television, textbooks, instruction booklets, and slides which are used in learning situations where individual students control the rate or procession.
Dwyer (1978) compared methods of presentation. In the first study the results showed that no significant difference was found between students receiving oral instruction and those that read the material. There was no visualization. The programmed method resulted in higher scores than the televised or slide methods, and also required less time. In the second study the effects of externally paced vs. self-paced instruction was compared (slide/audiotape vs. programmed instruction), and the results suggested that programmed instruction was more effective than the externally-paced method. In addition the colored version seemed more effective. Chance (1960) also found that color was more effective. It seemed that colored transparencies improved students' attentiveness and saved them time.

Dwyer also compared three types of black and white visuals—simple line drawings; detailed, shaded drawings; and realistic photographs. Three studies involved the use of these kinds of visuals—slide, television and programmed instruction. The combination slide study and simple line illustrations suggested learning facilitation. In the programmed instruction the realistic photographs were the facilitators, however, the treatment with no visuals was as effective as the ones with visualization. A reduction of time was found to reduce the effectiveness of the visuals, thus, it seemed that realistic visuals stimulated subjects more than simple line drawings and the amounts of time for viewing became an important variable. The success of visuals seemed to be dependent upon how readily a student could integrate the linguistic and pictorial inputs to form a common conceptual unit.
The following discussion relates to externally visualized instruction. Some types of visualized instruction did not equally affect oral instruction. Realistic photographic presentations were not as complementary to oral instruction as other types of visualization. Simple line drawings complemented oral instruction more appropriately such that achievement improved; however, sometimes oral instruction alone was effective. The same visuals served to complement oral instruction equally with 9-12 grade boys and girls.

Learning via visuals often depended upon grade level, and color seemed to improve comprehension at certain grade levels. Sometimes visuals caused differential effects, but they usually disappeared on delayed retention tests. There were different types of visuals, and each type had a different effect on achievement (e.g. color vs. black and white). The types of visuals chosen by students were not necessarily the ones which increased their achievement, and visuals were not equally effective with students of varying degrees of ability. Color seemed to reduce achievement differences and increase achievement; however, students of high ability scored higher regardless.

Students needs, viewing times, and visual size had to be considered, because only certain types of learning was affected by visualization. Line drawings seemed to increase achievement; however, television instruction complemented with visuals did not always result in better achievement. Similarly, increasing visual size often had an adverse effect on learning; but line drawings used with questions increased achievement (Dwyer, 1968a, 1968b, 1969a, 1969b, 1971a, 1971b,

Realism in color and materials seemed to enhance achievement. There was an interaction between an individual's level of dogmation and ability to learn from color and visuals; however, learner achievement was not the same for different types of color used on visuals of similar complexity, and after two weeks realistic colored visual effects disappeared. The achievement of students with lower I.Q.'s was not affected by extreme realism in visuals, but as usual, students with high I.Q.'s achieved higher regardless (Berry, 1974, 1976a).

The following features were based on studies of self-paced visualized instruction. Different types of visuals were not equally effective as complementary to oral instruction. Student achievement was improved by visuals; however, the realistic photographs were found even more effective. As before, often oral instruction alone was effective.

Programmed instruction booklets required more time than textbooks; however, those receiving textbooks did as well as those receiving programmed treatments. It seemed that programmed instruction used with simple line drawings required more time, but when used with photographic presentation, achievement was higher. Interestingly, students thought their achievement would increase with detailed, shaded drawings.

Achievement was not enhanced when students were instructed to focus on realistic visuals, but achievement was increased when they
were given instructions as cues to complement simple line presentations. More time was also required to process programmed instruction complemented by simple line color visuals.

Once again, high achievers' scores remained high, but visualization increased the achievement of low and medium achievers. Performance differences among students with varied entering behaviors was reduced with the use of detailed, shaded drawings; however, the black and white simple line drawing was the visual most effective in reducing performance differences in students with high, medium, and low entering behaviors. Those students having low and medium entering behaviors required more processing time for processing realistic presentations. Color was effective in reducing differences while simultaneously increasing achievement.

When combining treatment, simple line drawings, and realistic photographs were the most effective in increasing achievement, but the simple line drawings seemed to be the most effective when achievement was measured by drawing and identification tests (Dwyer, 1967b, 1968d, 1969e, 1969f, 1971d, 1971e, 1972b, 1975, 1977b). Similar findings were reported by Parkhurst (1974, 1975). The results reported from studies conducted on self-paced visual instruction related to textbooks were quite similar to the results from Dwyer's and Parkhurst's studies above; however, one major difference was evident on the drawing measure. Achievement was most effectively facilitated by the detailed, shaded, drawing visual. Another interesting aspect was that those receiving visuals did as well as those not receiving them (Dwyer, 1971f, 1971g, 1971, 1973a, 1970b, 1973b, 1973c).
Further analyses of textbook-line research led to some interesting conclusions. Achievement was often reduced if elaborate feedback strategies were used. Achievement was also adversely affected if the presentation formats were varied, but not the visuals.

Students entering with prior knowledge always out-performed those with no previous knowledge. Explicitness had no recall effect, and cognitive ability was impaired when instructional units were designed to improve achievement. The individual student differences seemed to be reduced by the design of the instructional unit.

The discussion above indicates that visualization, if appropriately chosen and used, can increase achievement. Industrial arts is certainly an extremely visual field, thus it makes sense to study the effects visuals have. There is much that could be taught through the use of visuals which could alleviate the need for laboratory experience, in some cases. It has been found that a visual-imitation program was effective in teaching psychomotor tasks in industrial education. This program eliminated a lot of the verbalization and taught by observation and imitation (Bender, 1971). In the case of orthographic projection, students learned more effectively with pictorial drawings or no aids rather than scale models (Bjorkquist, 1965). In the field of mathematics, Hayes (1971) concluded that notation-relation imagery played an important role in the solution of elementary mathematical problems. This was because they carried spatial information about shape, orientation, size, etc. They also induced subjects to construct hybrid images by combining the physical stimulus with generated images in an unified spatial schema, which could then be used in the solution of problems.
In summary, it seems clearly evident that visuals are effective, if used appropriately, in improving achievement (comprehension). However, it must be remembered that in using visuals many factors have to be considered in making decisions regarding how and when to use various types of visuals. One must be aware of the kinds and uses of visuals; otherwise, it is very possible for visuals to have a detrimental effect (Dwyer, 1978).

**The Enactive Mode of Learning**

As mentioned in the previous section, the more concrete the learning experience the more valuable it becomes. Dale's Cone of Experience (1974) identified the levels from the most abstract to the most concrete (see Figure 1). Bruner (1966) determined three major modes of learning: the enactive (direct experience), the iconic (pictorial experience), and the symbolic (highly abstract experience). Each of these involves actions; however, the level became less abstract as the "doing" increased. For example, the symbolic involved reading or hearing about concepts, while the iconic involved the students in observation; they looked at pictures, films, or drawings to learn how to do the ideas behind the concept, or to understand the underlying ideas behind the concept. The enactive actually involved the student in "doing" or performing critical aspects of the concept(s) to be acquired.
Dale (1974) discussed the process of abstraction. The best method to begin learning is through direct experience (Dewey, 1950); however, these experiences are gradually decreased and learning more often occurs by way of iconic representations or symbolism as substitutes. This is where the field of industrial arts is different. The experiences are very concrete. The laboratories are set up such that students experience the content of the subject matter individually. There is a need, however, to structure the less concrete matter, technical concepts, much more closely. There is a definite need for identification and organization of these technical concepts. At these stages, people begin to develop in their ability to summarize an idea by using a symbol. For example, when using the term "dog", a person summarizes all his experiences (first, direct, and second-hand, pictorial, or symbolic) with dogs. The problem that arose, however, was very serious. If a person has had more of the less concrete experiences and little direct contact with them, the concept has very little real meaning. If a verbal symbol has no referent, and it does not resemble anything, a person may have difficulty in relating it to his own experience.

The following studies relate to the controversial issue of whether enactive experience facilitates learning or comprehension.

Some of the results of various studies suggest that industrial arts activities stimulate interest, as well as provide a means of demonstrating the value of other subjects (Champion, 1965). Constructional
opportunity seemed to give students with high ability an additional opportunity for increased achievement, as well as to stimulate higher achievement in low ability students. Therefore, it seemed to be an effective alternative to traditional teaching (Downs, 1968; Logan, 1973). In relating industrial arts experiences to science concepts, industrial arts experiences, did, in fact, make a significant contribution to the understanding of scientific concepts. However, industrial arts related better to physical science than biological science (Griffin, 1965; Pershern, 1967). Regarding the integration of industrial arts activities on social studies achievement, Ingram (1966) found that activities did not prevent achievement and that students learned a lot and had fun. Achievement was not significantly improved, but their silent reading comprehension and work study skills improved. The same kind of results were obtained when Thieme (1965) concluded his study using industrial arts activities with fifth grade classroom work. There were no significant improvements in construction activity, and traditional classes in work study skills, map reading, general map knowledge, and specific map knowledge. The teachers involved in Thieme's study felt that scheduled industrial arts classes would be more beneficial than integrating industrial arts activities.

Consideration of the effects of laboratory performance indicated that laboratory or simulated activities enhanced achievement or retention, and that laboratory performance activities did enhance the level of cognitive gain in basic electronics. A lower number of
hours, however, was necessary to produce a higher cognitive gain score. Thus, students seemed to perform at a higher level and their gain scores increased with laboratory experience (Ohrenberg, 1976; Spradling, 1974).

An increase in overt activities increased praxiological learning, but the increase was not significant if the overt ability time was 80 percent or over. Thus, overt activity time should be just over 60 percent (Asper, 1967). In the comparison of overt activity and time spent in conceptualization, those allowed overt practice with time spent in conceptualization out-performed those who only conceptualized about the activity (Clark, 1967).

On the other hand, Johnston (1956) found teacher demonstrations to be superior to shop activities as an instructional technique. Also, Lemasters (1979) did not find any significant differences in achievement or retention resulting from the effects of sketching practice as a part of an audio-visual presentation on graphical calculus.

Therefore, it seems that whether or not activity enhances comprehension still remains controversial. More research is needed to determine the advantages or disadvantages of overt activity, or the en-active mode of learning.

**Taxonomy vs. Schema**

This section is designed for the sole purpose of discussing the study executed by Rabinowitz and Mandler (1981 unpublished). These researchers investigated the effects on free recall of short phrases
or nouns which were presented one of three ways: taxonomically, schematically, or randomly. The subjects given the schematically blocked list showed characteristic differences in recall, and recalled more items. After that, a third experiment involved the subjects in sorting the materials into one of the three groupings: taxonomic, schematic, or free sort. This was done for the purpose of further assessment on the saliency of the organization. The results of this experiment varied. When subjects were given a list of nouns, the sorting resulted in taxonomic clusters. The subjects sorted the phrases schematically. The taxonomic organization was the more obvious type of organization. The taxonomic groupings had very few misclassifications; however, the schematic groupings were widely disagreed upon.

In discussion of the results, the researchers assumed that anticipation of the schematic organization could be expected to guide encoding and retrieval to a greater degree than taxonomic organization. Thus, the expectations could facilitate different processing characteristics which could be associated with different kinds of organization. The results supported this hypothesis. Both experiments resulted in the greater use of schematically blocked lists, but the results of the second experiment suggested that the subjects had both organizations equally available for use, and did use both. The schematic grouping was the less obvious of the two; but more was recalled when schematic organization was used. Finally, there was a disagreement between subjects and researchers in the way the stimulus materials were grouped schematically. It seemed the schematic organization provided organization in the facilitation of recall, but subjects were not able to use their expectations for encoding.
This study is directly related to the present research, and is the only one known to compare taxonomic and schematic organization.

Summary

Testing for language comprehension involves many areas of study as well as many factors. The study of language comprehension cuts across the fields of psychology, linguistics, rhetoric, English, reading, psycho-linguistics, physiology, etc. as well as the individual content areas. Some of the factors which have to be considered and controlled for are: vocabulary, syntax, context, semantics, inferencing, proximity, staging, cohesiveness, reading abilities, hearing abilities, memory, encoding, storage, retrieval, and many, many more. A researcher must still be concerned with finding an appropriate way to test for comprehension, e.g. cloze procedure, free recall, question-answer, etc.

Previous to Bartlett (1932) much of the work on comprehension was related more to memory for lists of words, nonsense syllables and phrases, and sentences, rather than statements in context, discourse, or prose. This limited the subjects as to the type of organization they could use during encoding, storage, and retrieval, and also did not allow much inferencing to take place because few referents were available in lists. There were no contexts in which to find cues for retrieval. Also, contexts provided cohesive stability within a passage as well as a staging structure. This enhanced memory; however, in studying memory of lists these factors were not present. Studying
memory for lists of nonsense syllables, words, and sentences does not seem to be a realistic situation. But these studies are not to be discounted, because they have brought about much insight into memory and have led to the more realistic type of studies on prose or discourse. Without the background the taxonomic studies provided, researchers would not have had a place to begin studying discourse or episodic memory. Whereas the taxonomic theory and its relationship to semantic memory seemed to, often unnaturally impose a structure on a person, the schema theory and its relationship to episodic memory seemed to rely upon a naturally evident structure inherent within a person. Therefore, the studies which considered discourse rather than lists for insight into comprehension were more realistic and lent themselves to the study of naturally occurring organization within a person rather than a researcher or study imposed one. People in daily situations encounter passages (written or oral) to comprehend, rather than lists. The psychological processes become more evident in the study of discourse than in the study of lists or taxonomies.

Consideration must be exercised in the use of visuals. They seem to clearly enhance comprehension if used appropriately. There are many types of visuals. These must be used with caution lest there be a detrimental effect on learning. Visuals can cause interference and have an adverse effect on learning.

The controversy still exists as to whether overt activity increases achievement (comprehension), due to there being support for its increasing comprehension as well as having no effect. More research is needed to determine the effects of overt activity.
Mandler has established the need to study in depth the two theories of organization: schema and taxonomy. Up until the present time each had been studied independently; however, the two had never been compared until the Rabinowitz and Mandler (1981) study. This research created support and added substance to the present study.
CHAPTER III

THE DESIGN OF THE STUDY

This chapter discusses the experimental design of the study, the research methods and procedures, and a description of the pilot study. The chapter is organized into ten sections: (1) pilot study, (2) stimulus materials, (3) criterion measures, (4) experimental design, (5) the null hypotheses, (6) sample description, (7) instructional procedures, (8) sequence of treatment and measurement, (9) data collection and analysis, and (10) summary.

Pilot Study

A pilot study was conducted to develop and test the instructional materials, tests, and experimental procedures. It was conducted at Manteo High School in Manteo, North Carolina by two teachers, four senior girls, and the researcher. An intact class of 34 junior high students was used. The pilot study was conducted for the following reasons:

1. To test and improve the instructional procedures: introductory statements, timing, physical arrangements, teacher instructions, etc.

2. To determine the time required for the instruction, transition, and testing.
3. To determine the suitability of the tapes and visual illustrations to be used.
4. To provide experience, in anticipation of difficulties, in carrying out the experiment.

Several changes were made on the basis of the information provided by the pilot study. Prior to the pilot study, the teachers were briefed and told what to do. Because this procedure failed to produce uniformity in procedures, a briefing explicit plus written directions of all to be made to the students and a description of the sequence of events was provided. The tapes (criterion measure tapes) were shortened from about 45 minutes to approximately 31 minutes by shortening the time for response from 30 seconds to 10 seconds. The students were told they must follow the narration and not go ahead of it in completing the test. In the pilot, several students finished the test before the tape, thus giving them idle time. In the study more people were used to monitor the students' move from one classroom to another. Originally, an analysis of variance was used to analyze data from the eight treatment groups. The comparison of the ninth control group to the eight treatment groups was analyzed using a series of Fisher's t-tests. This was a poor choice of statistical procedure because it was not a balanced design and the alpha level was unstable. There were no significant differences found in the pilot study.
Stimulus Materials*

Three types of stimulus materials were developed for this study: (1) audio-taped presentations 3 minutes in length, (2) graphical illustrations of the presentations used as visuals, and (3) an enactive performance.

Modes of Presentation

The audio-tape method of presenting the passage was chosen for the following reasons: (1) to control for varying degrees of reading abilities among the students, (2) to control the amount of time required by the initial presentation, and (3) to insure that all groups received the same message (treatment).

Types of Presentation

The textual presentations were either taxonomically arranged or schematically arranged. A taxonomically organized presentation (passage) merely presents the facts, and has not temporal or spatial sequence established among the statements; a schematically organized passage has clearly established temporal and/or spatial sequences. One can tell if an event or episode comes first, second...last, or before or after, because of the temporal words within the passage. But in a taxonomically organized passage this is not established at all. One can identify the parts, or various episodes or events; however, the temporal arrangement is left up to the person to establish or

*Complete transcripts of the stimulus materials are found in the appendices in the following order: Appendix A, Taxonomic Presentation; Appendix B, Schematic Presentation; Appendix C, Taxonomic Visual and Tape Transcript; and Appendix D, Schematic Visual and Tape Transcript. Also, one may review Appendix E to see the lists of combinations of propositions and a propositional breakdown of text sentences.
identify. The schematic text passage also was written narratively or in story format.

The factors controlled by the tape passages were number of propositions and combinations of types of propositions. It was possible to have these types of combinations of propositions: (1) single-predicate, single-argument, (2) multiple-predicate, single argument, and (3) single-predicate, multiple-argument. There were 22 single-predicate, single argument, 27 multiple-predicate, single-argument, and 8 single-predicate, multiple-argument propositions. In controlling for the propositional factors, the researcher also controlled the amount of processing involved in comprehending the passages. There were equal amounts of propositions and proposition combinations in the two types of presentations, taxonomic and schematic. There were 57 propositions in each of the taxonomic and schematic presentations as well as equal numbers of the combinations mentioned above.

The content information for the passages was taken from the section on "casting" contained in The World of Manufacturing instructional text (Lux & Ray, 1971, p. 318). The passages (taxonomic and schematic) both contained the same information; however, the schematically organized passage was one-fourth page longer due to the temporal words within the passage.

**Visuals**

The textual presentations (taxonomic and schematic) were graphically illustrated, and used as text coordinated visuals. The
taxonomic illustration was a hierarchic presentation consistent with information in the taxonomic presentation, and the schematic illustration was a flow diagram consistent with the information presented in the schematic presentation. Both of these were black and white line drawings. They were developed by the researcher and reviewed and approved by the industrial arts members of her committee, Willis E. Ray, E. Keith Blankenbaker, and Donald G. Lux. A one minute audio-tape was used in coordination with each type of visual. This tape took the subjects through the visual parts step by step and identified each element contained within the visuals.

**Enactive Performance**

One-half of the treatment groups were allowed to perform the technical aspects of casting through involvement in a slip casting activity. Each subject within the activity treatment groups received a screened container, stir stick, cup of slip, plaster mini-mold, and rubber bands. The subjects were told to do exactly what the passages indicated, i.e. stir the slip; strain the slip; pour the slip into the mold; allow edges to thicken; pour out the excess slip; allow the clay to harden, etc. Seventy subjects were given the opportunity to perform the activity.

**Content Validity**

A jury was used to analyze the content validity of the textual presentations (audio-taped passages). Professors Willis E. Ray, Donald G. Lux, E. Keith Blankenbaker, and Donald G. Lux.

* A transcript of the activity instructions is in Appendix F.
Lux, and E. Keith Blankenbaker, who are each highly qualified to pass judgement as to industrial arts content validity, reviewed and approved the final passages. Two were authors and/or team members of the Industrial Arts Curriculum Project from which The World of Manufacturing emerged.

Organizational Validity

Dr. Victor M. Rentel served as the adviser on the taxonomic and schematic organization of the texts. In addition, he was involved in supervising, reviewing, and approving the breakdown of the passage statements into propositions.

Criterion Measures*

Types of Measures

There were two criterion measures: a cloze procedure test and a free recall; however, two scores were obtained from the cloze procedure, giving each subject a total of three scores or three measures.

The review of literature (Chapter II) served to support the use of free recall as a reliable measure of comprehension. The cloze procedure was acclaimed to be a reliable way to measure comprehension, as well (Bormouth, 1972; Jones & Pikulski, 1974; Anderson, 1974; Ganier, 1976; Kennedy & Weener, 1973).

The cloze test used in this study was oral in one sense, because an audio-tape took the subjects completely through the test allowing

* The criterion measures can be found in Appendix G.
10 seconds for the filling in of the blank. However, each subject had a copy of the entire textual passage and could read the statements as well as listen to the tape. Without this double exposure, problems could have been encountered, since these subjects had no previous experience with oral cloze and little experience listening to tapes (Neville & Pugh, 1974). The researcher hoped to alleviate problems, such as missing cues, by providing the subjects with written copy as well as an oral presentation. The tape also helped control for differences in reading abilities. The reliability coefficients established by Kuder-Richardson Formula 21 for the verbatim and synonym cloze were .95 and .97, respectively.

The written form of the cloze was typed, double-spaced with an allowance of fifteen typewritten spaces for each blank (Rentel, 1981), and every fifth word was deleted. The subjects were instructed to supply the deleted words and make the passage complete. They were also told to stay with the tape and not go ahead of it.

The entire cloze measure consisted of the two types of passages combined, thus making it possible to give all the groups, taxonomic, schematic, and no presentation, the same measure on comprehension. One-half of the subjects (randomly chosen) received the cloze test such that the taxonomic presentation was first on the test. The other one-half (also randomly chosen) received a cloze test which began with the schematic presentation. This procedure was used for the purpose of controlling for order of presentation. Each subject received a cloze test consisting of both the taxonomic and schematic passages with every fifth word deleted, and to control for ordering, one-half received a test with the taxonomic passage first (written and taped). The
other one-half received the cloze test with the schematic passage first. All subjects were tested on the information in both passages. Prior to the thirty minute test, the students were instructed to fill in the deletions when the narrator said "blank" with what they remembered of the information presented that morning.

The second type of measure was that of free recall. At the end of the treatment the subjects were asked to put down in written form everything they could remember about the morning's activities. They were given pencil and paper for this purpose and allowed fifteen minutes to complete the task. This was done before the cloze test.

**Scoring**

The cloze procedure tests were scored in two different ways. The first scoring was for verbatim words which fitted into the blanks as part of the original passages. The second scoring for idea units or synonyms which could adequately serve to establish the intended meaning; therefore, the wording used need not have been verbatim.

The free recalls were scored for idea units. In other words, the original list of propositions (acquired from the statements in the two passages) was used in conjunction with synonyms, and a rater's judgement was used as to what propositional credit could be given to the subject resulting from his/her written expression (see Appendix E).

The cloze tests were scored by an outside rater in both instances. They were then checked for error by both another outside person and the

* A list of synonyms used can be found in Appendix H.
researcher. The recalls were scored by an independent rater, as well as by the researcher. An interrater reliability of .99 was attained. The following procedure occurred in the first scoring: the rater had an entire list of propositions consisting of those from both passages, and the recall was searched for any of the verbatim propositions. In the second scoring, the rater looked for anything synonymous with the verbatim propositions. Finding either type of appropriate response, the rater marked through the proposition (either verbatim or synonym) on the list, counted the total marked, and marked the score at the top of the proposition list rather than the recall. This kept the second rater from viewing the score determined by the first rater. The second rater used a propositional list and marked the score on the recall itself.

Rater Training

The training for the cloze procedure measures was minimal. It required an explanation of how to use the verbatim and synonym lists of correct answers, and where to put the score of correct answers for each subject. The training for scoring the recalls was more involved. It was difficult to find someone who would take the time necessary to read the recalls and spend the judgemental time necessary to make decisions regarding the recalls; however, this researcher happened upon a person who had a natural instinct for language and who had very little difficulty understanding the propositional structure or the
crediting of synonymous propositions. This is not the usual case for, in daily encounters with other doctoral students and/or professors, it is difficult for persons to understand the propositional breakdown for a statement or passage. The process rather technical and in this case, not a normal part of the field content (industrial arts). Therefore, in replicating this study, this factor must be considered and remembered. An outside rater must be trained to score free recalls.

**Experimental Design**

The experimental design used in this study was the experimental post-test only control group (Campbell & Stanley, 1963), utilizing thirteen treatment groups and one control group. Each group had a n of 10, the total N equalling 140 subjects (see Figure 4).

The statistical design used was a three-factor, randomized experimental design, with the subjects being randomly assigned to their treatment groups. It was not necessary to use intact classes because the whole seventh and eighth grade classes were used. The three independent variables were: (A) organization of text, (B) visuals, and (C) enactive performance. There were also three dependent variables: (1) cloze verbatim score, (2) cloze idea score, and (3) recall score. The levels of the independent variables follow: (see Figure 4)

A. Organization of text
   - Level 1 - taxonomy
   - Level 2 - schema
   - Level 3 - no presentation (control group)
The Null Hypotheses

The statements of null hypotheses follow:

Ho₁: There is no significant difference in initial learning between the subjects who receive the taxonomically organized passages, those who receive the schematically organized passages, and those who receive no passage presentation.

Ho₂: There is no significant difference in the initial learning between the subjects who receive text coordinated visuals and those who receive no visuals.

Ho₃: There is no significant difference in the initial learning between the subjects who receive opportunity for enactive performance and those who receive no opportunity for enactive performance.

Ho₄: There is no significant difference in the initial learning between subjects receiving the following combinations:

1. Taxonomy/Taxonomic Visual/Activity,
2. Taxonomy/Taxonomic Visual/No Activity,
3. Taxonomy/No Visual/Activity,
4. Taxonomy/No Visual/No Activity,
(5) Schema/Schematic Visual/Activity,
(6) Schema/Schematic Visual/No Activity,
(7) Schema/No Visual/Activity,
(8) Schema/No Visual/No Activity,
(9) None/Taxonomic Visual/Activity,
(10) None/Taxonomic Visual/No Activity,
(11) None/No Visual/Activity,
(12) None/No Visual/No Activity,
(13) None/Schematic Visual/Activity,
(14) None/Schematic Visual/No Activity.

**Sample Description**

The subjects used for this study were 140 seventh and eighth graders (60 seventh and 80 eighth) who were the total junior high section of Manteo High School, Manteo, North Carolina, with the exception of the one intact class used for the pilot study.

This school and these subjects were chosen for the following reasons:

1. The administrators allowed the total enrollment of junior high seventh and eighth graders to participate with no restrictions imposed upon the organization of the experiment (e.g. did not have to use intact classes).

2. Teachers and administrators volunteered to help set up and execute the experiment.

3. A sufficiently large group of students were available (N = 174).
4. The whole junior high section was available, such that no group was aware at the time of the experiment that one group was being treated differently from any other.

5. The entire experiment was conducted simultaneously with all treatments given at the same time.

Manteo is a rural town located on the coast of North Carolina in Dare County. The rather isolated county is largely economically supported by tourists, the fishing industry, and supporting positions. This school was chosen because of its cooperative attitude, availability to the researcher, and finally, because it had not been involved in previous studies. Therefore, the students were not "test or experiment wise".

**Instructional Procedures**

The teachers were briefed as to their duties and positions within the classrooms and the experiment. They were given an outline of procedures to follow, as well as instructions for the students. Each teacher had a list of students to expect and check for at each stage of the experiment, as well as a list of those who were to leave at various times during the experiment.

**Sequence of Treatment and Measurement**

The students met, as usual, in their homerooms. The homeroom teachers gave each student a room number to report to for the first period.
The teachers checked the students' names off a list as they entered the class. See Figure 5 for group assignments to rooms. The researcher substituted alternate students for those absent. It happened that there was a \( n = 10 \) subjects for each group equalling a total \( N \) of 140.

The experiment began with an initial playing of the textual presentation tapes (3 minutes in length). After the first playing, the groups receiving visuals were told to view the visuals for a few seconds, and then a tape was played which took them through the entire visual (approximately one minute). Those receiving no visuals were told to be quiet and the subjects put their heads on their desks for one minute. The presentation tapes were played a second time for repeated exposure to the textual presentations. The students were allowed to keep the visuals during the second playing of the textual tapes. Those students receiving visuals were in separate rooms from those not receiving visuals. The control group also, was separated. The groups receiving no presentations were allowed to play card games.

Following the taped and visual/rest presentation, the teachers read out the names of the students who were to report to the room where the opportunity for enactive performance was to occur. The students were escorted, silently, by senior students from the high school, with the exchange of classrooms monitored by the researcher. (See Figure 5.) Those students who performed the act of slip casting were instructed and directed through the entire procedure and were monitored by senior students as well as the researcher. While the activity groups were performing, the students who remained in the classroom and received no opportunity for activity were told to write a story on the history
of Dare County. They were given pencil and paper for this purpose. This phase of the experiment took approximately 30 minutes. The students, after the activity, were then escorted to their rooms for testing.

Testing occurred in the following sequence. First, the students were told to write a recall of their experience during the morning. Subjects were allowed fifteen minutes to do so. Then they were instructed to follow a test tape and fill in the blank with the missing word when the narrator said "blank." This took approximately thirty minutes.

The entire experiment took approximately two hours and 45 minutes. It went smoothly and quietly, with the students and teachers performing to perfection.

Data Collection and Analysis

The nature of the data collection procedure has been implied. For the purpose of being explicit, however, it was accomplished in this manner: the dependent variables were the measures resulting from three test scores (cloze verbatim, cloze idea, and free recall); the tests were rated and scored (discussed in the criterion measure section) giving each subject a total of 3 scores. The total test time was approximately 45 minutes; fifteen for free recall and 30 for cloze.

Students' raw score data (number of correct responses) were analyzed three separate times employing analysis of variance as the statistical procedures; one for each type of score. A model summary of the statistical analysis is shown in Table 1. Both Tukey and Scheffé post hoc tests were employed to assess significant interactions and main effects.

The Tukey formula and Scheffé formula can be found in Appendix J.
<table>
<thead>
<tr>
<th>Organization of Text</th>
<th>Visuals</th>
<th>Activity</th>
<th>Group Number</th>
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<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td><strong>Level 1 Taxonomy</strong></td>
<td>(Level 1) Visual</td>
<td>(Level 1) Activity</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>(Level 2) No Visual</td>
<td>(Level 2) No Activity</td>
<td>2</td>
</tr>
<tr>
<td><strong>Level 2 Schema</strong></td>
<td>(Level 1) Visual</td>
<td>(Level 1) Activity</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>(Level 2) No Visual</td>
<td>(Level 2) No Activity</td>
<td>6</td>
</tr>
<tr>
<td><strong>Level 3 No Presentation</strong></td>
<td>(Level 1) T Visual</td>
<td>(Level 1) Activity</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>(Level 1) T Visual</td>
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<td>10</td>
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<tr>
<td></td>
<td>(Level 2) No Visual</td>
<td>(Level 1) Activity</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>(Level 2) No Visual</td>
<td>(Level 2) No Activity</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>(Level 1) S Visual</td>
<td>(Level 1) Activity</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>(Level 1) S Visual</td>
<td>(Level 2) No Activity</td>
<td>14</td>
</tr>
</tbody>
</table>

Figure 4
Group Description
Figure 5
Classroom Setup for Study and Group Assignments
**Table 1**  
ANOVA Summary Table for Three-factor Design

<table>
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<th>Source</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
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<td>A</td>
<td>(a-1)</td>
<td>SS(A)/a-1</td>
<td>MS(A)/MS(S/SBC)</td>
</tr>
<tr>
<td>B</td>
<td>(b-1)</td>
<td>SS(B)/b-1</td>
<td>MS(B)/MS(S/ABC)</td>
</tr>
<tr>
<td>C</td>
<td>(c-1)</td>
<td>SS(C)/c-1</td>
<td>MS(C)/MS(S/ABC)</td>
</tr>
<tr>
<td>AB</td>
<td>(a-1)(b-1)</td>
<td>SS(AB)/(a-1)(b-1)</td>
<td>MS(AB)/MS(S/ABC)</td>
</tr>
<tr>
<td>AC</td>
<td>(a-1)(c-1)</td>
<td>SS(AC)/(a-1)(c-1)</td>
<td>MS(AC)/MS(S/ABC)</td>
</tr>
<tr>
<td>ABC</td>
<td>(a-1)(b-1)(c-1)</td>
<td>SS(ABC)/(a-1)(b-1)(c-1)</td>
<td>MS(ABC)/MS(S/ABC)</td>
</tr>
<tr>
<td>S/ABC</td>
<td>abc (n-1)</td>
<td>SS(S/ABC)/abc(n-1)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>abcn-1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Summary

Chapter III has presented a description of the pilot study and the manner in which the stimulus materials and criterion measures were developed. Presented also was the experimental design and null hypotheses. Descriptions were given of the instructional procedures, the treatment and measurement sequence, and data collection and analysis procedures.

Chapter IV will present an overview of test data and a description of the analysis of data by analysis of variance. There will be a report of the findings, together with a testing of the null hypotheses. A discussion of the outcome of the experiment will also be presented.
CHAPTER IV

ANALYSIS OF THE DATA

This chapter presents the findings resulting from an analysis of the experimental data. Included within the chapter are tables and figures summarizing the results of the analysis of variance procedures and the post hoc analyses. The Table of Treatment Means and Standard Deviations (Groups 1-14) is not presented within this chapter, but can be found in Appendix I.

Using the Statistical Package for the Social Sciences (Nie, Hull, Jenkins, Steinbrenner, Bent, 1975) as the mode of analysis, the analysis of variance statistical program was employed for the computer analysis of the experimental data. An analysis of variance was performed for each of the three dependent measures, verbatim cloze, idea cloze, and recall. A second analysis of variance was performed for an isolated set of groups for each of the three measures. This second analysis was performed on Groups 9 through 14, which received no textual presentation, as a means to test the effect of visual presentation.

Chapter IV is organized into the following sections: (1) review of the criterion measures; (2) restatement of the null hypotheses; (3) discussion of the results of the analysis; and (4) chapter summary.
Review of the Criterion Measures

There were two criterion measures for which three scores were obtained: (1) the oral cloze procedure test and (2) a free recall measure. The oral cloze procedure test was scored using two different methods, thus resulting in two scores per subject. The reliability for the cloze was .95. The first scoring was based on verbatim responses of each subject. The second scoring was based on ideas or synonymous responses for the verbatim responses in the first scoring. In the first scoring, a subject may have had a right answer yet it was scored as incorrect because it was not verbatim from the presented text. In the second scoring the same responses could be scored as correct for having appropriate ideas. The third score for each subject was the production on a free recall test, where subjects were asked to write on blank paper all that they could recall of their experiences. There was an inter-rater reliability of .99 for the recall scorings.

Restatement of the Null Hypotheses

Below are statements of the null hypotheses for the study:

$H_{01}$: There is no significant difference in initial learning between the subjects who receive the taxonomically organized passages, those who receive the schematically organized passages, and those who receive no passage presentation.

$H_{02}$: There is no significant difference in the initial learning between the subjects who receive text coordinated visuals and those who receive no visuals.
Ho₃: There is no significant difference in the initial learning between the subjects who receive opportunity for enactive performance, and those who receive no opportunity for enactive performance.

Ho₄: There is no significant difference in the initial learning between subjects receiving the following combinations:

(1) Taxonomy/Taxonomic Visual/Activity,
(2) Taxonomy/Taxonomic Visual/No Activity,
(3) Taxonomy/No Visual/Activity,
(4) Taxonomy/No Visual/No Activity,
(5) Schema/Schematic Visual/Activity,
(6) Schema/Schematic Visual/No Activity,
(7) Schema/No Visual/Activity,
(8) Schema/No Visual/No Activity,
(9) None/Taxonomic Visual/Activity,
(10) None/Taxonomic Visual/No Activity,
(11) None/No Visual/Activity,
(12) None/No Visual/No Activity,
(13) None/Schematic Visual/Activity,
(14) None/Schematic Visual/No Activity.
Discussion of the Results of the Analyses

This research study employed Fisher's completely randomized design, where subjects were randomly assigned to the various levels and combinations of treatments (see Figure 4). The independent variables, measured by instruments which were administered to the subjects, were organization of text (A), visuals (B), and enactive performance (C). Each variable level was crossed with every other variable level; the subjects were randomly assigned to these levels using a random table of numbers. These qualitative independent variables were fixed such that their levels were of direct subject matter interest to the researcher. The unit of analysis was the treatment groups. For all statistical analyses the alpha level was set at the .05 level.

The First Analysis

The first null hypothesis \( H_0 \) was rejected since significant organization differences were demonstrated. There was a significant main effect of organization for the dependent variable recall, \( F(2,128) = 3.590, p \leq .030 \) (see Table 2). This main effect had to be interpreted in terms of the significant interaction between organization and visual, \( F(2,128) = 4.613, p \leq .012 \). The interaction was disordinal, thus a main effect statement could not be made without conditions. This interaction will be analyzed further in the testing of Hypothesis 4 (see Figure 6).

The verbatim cloze analysis resulted in no significant differences between levels of organization means, \( F(2,128) = 1.315, p \leq .272 \), as did the idea cloze analysis, \( F(2,128) = 2.970, p \leq .055 \) (see Tables 3 and 4 respectively).
The second null hypothesis (H02), visuals versus no visuals, was rejected. There was a significant visual main effect, $F(1,128) = 4.881$, $p < .029$, in the verbatim cloze analysis (see Table 3). The resultant significant $F$ and the inspection of the two groups means demonstrated that the visual group ($\bar{X} = 48.52$) performed higher than the no visual group ($\bar{X} = 40.9$) as measured by the verbatim cloze test.

The idea cloze analysis, $F(1,128) = 3.133$, $p > .079$, and the recall analysis, $F(1,128) = 3.458$, $p > .065$, was not significant (see Tables 4 and 2 respectively).

The third null hypothesis (H03), activity versus no activity, was rejected. For the dependent variable recall, the analysis produced a significant activity main effect, $F(1,128) = 31.351$, $p < .001$ (see Table 2). This main effect had to be interpreted in terms of the significant visual and activity interaction, which was ordinal, $F(1,128) = 6.584$, $p < .011$. Activity sometimes produced higher means than no activity; however, the difference was significant only where there was no visual. This interaction will be discussed further in the testing of Hypothesis 4 (H04) (see Figure 7).

For the dependent variable verbatim cloze, the analysis resulted in no significant differences for activity, $F(1,128) = 0.31$, $p > .860$ (see Table 3). Activity was also not significant, $F(1,128) = .003$, $p > .953$ for the analysis of the idea cloze (see Table 4).

The fourth null hypothesis (H04), which investigated variable interaction, was rejected. This hypothesis consisted of fourteen sub-statements regarding possible organization, visual, and activity interactions. There were significant differences evident in the analysis of variances in terms of
this hypothesis. For the recall test, the analysis produced a significant interaction between organization and visuals (AB), $F(2,128) = 4.613$, $p \leq .012$, and between visuals and activity (BC), $F(1,128) = 6.584$, $p \leq .011$. There was no significant interaction between organization and activity (AC), $F(2,128) = 1.369$, $p \geq .0258$; nor was there a significant interaction between organization, visuals, and activity, $F(2,128) = 1.482$, $p \geq .231$ (see Table 2).

It was necessary to follow up the significant interactions of organization and visuals (AB) and visuals and activity (BC) to determine exactly where the significant differences were, as well as to interpret the main effects for the recall analysis. The Scheffé post hoc for unequal $n$ for multiple comparisons was used as the follow up test for both interactions.

The organization and visuals (AB) interaction was disordinal (see Figure 6). Testing for all possible mean differences using the Scheffé formula, the only significant difference observed was the comparison between schematic organization and taxonomic organization at the no visual level for variable (B), $F(5,128) = 2.64$, $p \leq .05$. Therefore, a conditional main effect statement could be made. The Scheffé analysis results can be interpreted as follows. There was a significant difference in schematic and taxonomic organization when there was no visual with the schematic organization groups scoring higher. There were no significant differences among organization means for the visual condition of variable B.

The visual and activity (BC) interaction was ordinal (see Figure 7). Therefore, a main effect statement was made. The groups
receiving the opportunity for enactive performance always scored higher than those not receiving the opportunity to experience enactive performance, but there was a significant difference only between activity and non-activity at the no visual level, $F(3,128) = 6.736, p \leq .05$.

Thus, for the significant interactions of organization and visuals (AB), and visuals and activity (BC), the groups attained higher scores when activity was not accompanied by visuals and when taxonomic organization, rather than schematic or no organization, was not accompanied by visuals.

There were no significant differences found in the verbatim cloze analysis:

1. organization/visual interaction (AB), $F(2,128) = 2.540$, $p \leq .083$,
2. organization/activity interaction (AC), $F(2,128) = 0.11$, $p > .989$,
3. visuals/activity interaction (BC), $F(1,128) = .727$, $p \geq .395$,
4. organization/visuals/activity interaction (ABC), $F(2,128) = .144$, $p \leq .866$ (see Table 3).

The idea cloze resulted in no significant differences, as well.

The results of the analysis were:

1. organization/visuals interaction (AB), $F(2,128) = 1.328$, $p \leq .269$,
2. organization/activity interaction (AC), $F(2,128) = 0.040$, $p \leq .961$,
3. visuals/activity interaction (BC), $F(1,128) = .135$, $p \geq .714$,
4. organization/visuals/activity interaction (ABC), $F(2,128) = .411$, $p \leq .664$. 


The Second Analysis

A second analysis of variance was performed on Groups 9 through 14 which received no textual presentation. For each level of variable B, taxonomic visual, schematic visual, and no visual, one-half received the enactive performance treatment, while the remaining subjects did not (see Figure 4). Three different levels of visuals were used, a taxonomic visual, a schematic visual, and none (no visual). Because of the three levels of visuals, the overall research design was unbalanced. The third type of organization (none) required six groups of visuals. In performing the first analysis of variance, taxonomic and schematic levels of the visual variable were collapsed for the no organization level. Therefore, the second analysis was performed to determine the effect of the taxonomic visual over the schematic visual, as well as the overall effect of visuals (taxonomic and schematic) versus no visuals. The third level, none, of organization (variable A) was isolated for this second analysis. Each dependent measure, verbatim cloze, idea cloze, and recall was exposed to the analysis of variance.

There was no textual organization in this analysis. Therefore, the first hypothesis was not relevant and consequently not tested.

The second null hypothesis (H02) visuals versus no visuals, was not rejected. There were no significant differences to be considered for the visual variables (B):

\[ F(2,54) = .305, p \leq .738 \text{ on the verbatim cloze (see Table 5);} \]
\[ F(2,54) = .081, p \leq .922 \text{ on the idea cloze (see Table 6); and} \]
\[ F(2,54) = 2.101, p \leq .132 \text{ on the recall analysis (see Table 7).} \]
The third null hypothesis \((H_{o3})\), enactive performance versus no enactive performance, was rejected due to a significant activity main effect for the recall analysis, \(F(1, 54) = 11.553, p < .001\) (see Table 7). This main effect had to be interpreted in terms of the visuals/activity interaction, which was ordinal (see Figure 8). Although activity always produced higher scores than no activity, activity was only statistically significant from no activity at the no visual level.

The verbatim cloze for activity analysis resulted in no significant differences, \(F(1, 54) = .018, p > .894\) (see Table 5). The third dependent measure, idea cloze, also resulted in no significant differences for the activity variable, \(F(1, 54) = .0, p > 1.000\) (see Table 6).

The fourth null hypothesis \((H_{o4})\) was rejected since significant visuals/activity interaction could be demonstrated. Once again, as in the first set of analyses, the recall measure produced significant results. There was a significant interaction between visuals and activity, \(F(2, 54) = 8.354, p < .001\).

The visuals/activity interaction was ordinal for recall. Isolating the six no text organization groups, Tukey's HSD procedure for equal \(n\) was used as the follow-up post hoc analysis for multiple comparisons. Only the comparison between activity and no activity at the no visual level resulted in significance, \(F(5, 128) = 6.58, p < .001\). Although activity group means (\(\bar{x}\)'s) were always higher than those of the no activity groups means (\(\bar{x}\)'s), they were significantly different only when there were no visuals (see Figure 8).
There were no significant differences on the verbatim cloze analysis for the interaction of visuals and activity, $F(2,54) = .747$, $p \leq .479$. The results of the idea cloze analysis for the visuals/activity interaction were not significant, $F(2,54) = 7.43$, $p \leq .481$.

**Discussion**

The only significant interactions were those which, in fact, involved no real interaction of substance. In the visual/activity (both analyses) interaction, the interaction was significant only at the no visual level. In the case of the organization/visual interaction (first analysis), the interaction was significantly only at the no visual level. Therefore, it seemed rational to declare that schematic organization was alone enough to make a significant difference between the treatment groups. The same seemed to be true of the activity treatment, since, once again, activity alone made a significant difference. The enactive performance, however, was facilitated by step by step instructions. These instructions were of similar content to that of the textual presentations.

One could hypothesize that, in combining treatments (teaching methods), the effects on initial learning could be adverse or detrimental. Dwyer (1978) reported in various studies that if visuals were not appropriately chosen and used, there were often adverse effects on learning. Also, if different modes of instruction were not carefully chosen and/or combined, adverse effects may occur.
There is an obvious need for discussing the measurement of comprehension. Comprehension is an abstraction and can not be observed. So how does one, in reality, measure an abstraction? It is difficult to study learning because of the lack of adequate means of assessing what has been learned. Two basic types of assessment techniques have been employed: question-oriented techniques and free recall techniques. It is difficult to assess what information is learned; thus, the emphasis has shifted to how much information is retained. There are many problems. McConkie (1977) discussed the assessment of learning on retention.

In this study it was obvious that the three types of dependent variable measures (verbatim cloze, idea cloze, and recall) did not measure the same thing. There were no established patterns of scores; however, these types of measures were used as reliable measuring techniques. Correlations were calculated for scores by type of dependent variable. The coefficients were found to be as follows: verbatim/synonym = .25; verbatim/recall = .50; and synonym/recall = .01. Thus, the measures assessed different aspects of comprehension.

The verbatim and synonym cloze tests tapped memory for the author's expression and cued the responses. The synonym and recall tapped memory for "gist" or idea units and allowed free expression. The synonym cloze, however, still imposed the restriction of asking for recall of a specific idea. The written recall, on the other hand, gave full rein for recalling anything learned. Another factor must also be considered in the recall, that of verbal expression. Some
people understand, but lack the capabilities to reproduce knowledge verbally, orally or written.

Consideration must be given to the type of measurement used in conjunction with a particular type of teaching method. In the recall analysis on Groups 1-14, three percent of the variance was accounted for by the organization treatment, one percent by the visual treatment, and 16 percent by the enactive performance. One could contend that activity facilitates comprehension when using a free recall type of assessment; however, visuals and organization did not have much of an effect on free recall.

The cloze analyses for Groups 1-14 produced different percentages of the variance accounted for by treatment. In the case of the verbatim cloze analysis, the subjects were to recall specific items identified by the author, but the item could only be expressed by a pre-selected term. The cloze synonym analysis, however, allowed the subjects to express specific items in a manner they felt expressed the idea. Thus, the synonym allowed more freedom of expression, but both cloze tests had the limitations of asking for specific items. In general, activity had little effect in facilitating learning. It accounted for considerably less than one percent of the variance for each cloze measure. Organization and visuals accounted for more of the variance; however, these percentages were low. They were, for verbatim cloze, two percent for organization and 3 percent for visuals; for synonym cloze, four percent for organization and two percent for synonym. If anything contributed to learning, as measured by the cloze, it was the
organization and visual treatments. To summarize one must be as sure as possible that the assessment technique is appropriate for the teaching method implemented. Much more research is needed to determine the best or most appropriate measure for given situations. One could hypothesize that a measure which is adequate for one situation may not serve in a situation which involves learning technical concepts or information.

**Summary**

In summarizing the results of the experimental data analyses, a significant difference among organization means was found with schematic organization means greater than taxonomic and no organization, when presented without visuals. Activity also was significant, but only under the condition that it was used without visuals. The findings, therefore, indicate that schematic organization and enactive performance have a significant effect on initial learning in the case of technical textual discourse (slip casting), although only producing significant mean differences when not accompanied by visuals.
Table 2
Recall ANOVA Summary

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>Sig. of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Organization</td>
<td>2</td>
<td>180.366</td>
<td>3.590</td>
<td>0.030*</td>
</tr>
<tr>
<td>(B) Visuals</td>
<td>1</td>
<td>173.755</td>
<td>3.458</td>
<td>0.065</td>
</tr>
<tr>
<td>(C) Activity</td>
<td>1</td>
<td>1575.128</td>
<td>31.351</td>
<td>0.001*</td>
</tr>
<tr>
<td>(AB) Org/Vis</td>
<td>2</td>
<td>231.776</td>
<td>4.613</td>
<td>0.012*</td>
</tr>
<tr>
<td>(AC) Org/Act</td>
<td>2</td>
<td>68.772</td>
<td>1.369</td>
<td>0.258</td>
</tr>
<tr>
<td>(BC) Vis/Act</td>
<td>1</td>
<td>330.778</td>
<td>6.584</td>
<td>0.011*</td>
</tr>
<tr>
<td>(ABC) Org/Vis/Act</td>
<td>2</td>
<td>74.482</td>
<td>1.482</td>
<td>0.231</td>
</tr>
<tr>
<td>(S/ABC) Residual</td>
<td>128</td>
<td>50.241</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>139</td>
<td>67.866</td>
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</table>

*p ≤ .05

Table 3
Verbatim Cloze ANOVA Summary

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<th>F</th>
<th>Sig. of F</th>
</tr>
</thead>
<tbody>
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<td>694.727</td>
<td>1.315</td>
<td>.272</td>
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<tr>
<td>(B) Visual</td>
<td>1</td>
<td>2577.784</td>
<td>4.881</td>
<td>.029*</td>
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<td>(C) Activity</td>
<td>1</td>
<td>16.420</td>
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<td>.860</td>
</tr>
<tr>
<td>(AB) Org/Vis</td>
<td>2</td>
<td>1341.202</td>
<td>2.540</td>
<td>0.083</td>
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<tr>
<td>(AC) Org/Act</td>
<td>2</td>
<td>5.622</td>
<td>0.011</td>
<td>0.989</td>
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<tr>
<td>(BC) Vis/Act</td>
<td>1</td>
<td>383.911</td>
<td>0.727</td>
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<tr>
<td>(ABC) Org/Vis/Act</td>
<td>2</td>
<td>76.187</td>
<td>0.144</td>
<td>0.866</td>
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<tr>
<td>(S/ABC) Residual</td>
<td>128</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>139</td>
<td>535.769</td>
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*p ≤ .05
### Table 4
Idea Cloze ANOVA Summary

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</thead>
<tbody>
<tr>
<td>(A) Organization</td>
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<td>2503.559</td>
<td>2.970</td>
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<tr>
<td>(B) Visuals</td>
<td>1</td>
<td>2641.100</td>
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<tr>
<td>(C) Activity</td>
<td>1</td>
<td>2.945</td>
<td>0.003</td>
<td>0.953</td>
</tr>
<tr>
<td>(AB) Org/Vis</td>
<td>2</td>
<td>1119.819</td>
<td>1.328</td>
<td>0.269</td>
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<tr>
<td>(AC) Org/Act</td>
<td>2</td>
<td>33.329</td>
<td>0.040</td>
<td>0.961</td>
</tr>
<tr>
<td>(BC) Vis/Act</td>
<td>1</td>
<td>114.036</td>
<td>0.135</td>
<td>0.714</td>
</tr>
<tr>
<td>(ABC) Org/Vis/Act</td>
<td>2</td>
<td>346.479</td>
<td>0.411</td>
<td>0.664</td>
</tr>
<tr>
<td>(S/ABC) Residual</td>
<td>128</td>
<td>843.049</td>
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<tr>
<td>Total</td>
<td>139</td>
<td>850.195</td>
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* p < .05
### Table 5

**Verbatim Cloze ANOVA Summary**  
For Groups 9 Through 14

<table>
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<tr>
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<th>F</th>
<th>Sig. of F</th>
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</thead>
<tbody>
<tr>
<td>(B) Visuals</td>
<td>2</td>
<td>162.817</td>
<td>0.305</td>
<td>0.738</td>
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<tr>
<td>(C) Activity</td>
<td>1</td>
<td>9.600</td>
<td>0.018</td>
<td>0.894</td>
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<tr>
<td>(BC) Vis/Act</td>
<td>2</td>
<td>398.150</td>
<td>0.747</td>
<td>0.479</td>
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<tr>
<td>(S/BC))Residual</td>
<td>54</td>
<td>533.024</td>
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<tr>
<td><strong>Total</strong></td>
<td>59</td>
<td>507.031</td>
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</tbody>
</table>

* \(p < 0.05\)

### Table 6

**Idea Cloze ANOVA Summary**  
For Groups 9 Through 14

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>Sig. of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>(B) Visuals</td>
<td>2</td>
<td>62.517</td>
<td>0.081</td>
<td>0.922</td>
</tr>
<tr>
<td>(C) Activity</td>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
<td>1.000</td>
</tr>
<tr>
<td>(BC) Vis/Act</td>
<td>2</td>
<td>574.550</td>
<td>0.743</td>
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</tr>
<tr>
<td>(S/BC))Residual</td>
<td>54</td>
<td>52.079</td>
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<tr>
<td><strong>Total</strong></td>
<td>59</td>
<td>76.321</td>
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</tbody>
</table>

* \(p < 0.05\)

### Table 7

**Recall ANOVA Summary**  
For Groups 9 Through 14

<table>
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<th>MS</th>
<th>F</th>
<th>Sig. of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>(B) Visuals</td>
<td>2</td>
<td>109.429</td>
<td>2.101</td>
<td>0.132</td>
</tr>
<tr>
<td>(C) Activity</td>
<td>1</td>
<td>601.667</td>
<td>11.553</td>
<td>0.001*</td>
</tr>
<tr>
<td>(BC) Vis/Act</td>
<td>2</td>
<td>435.054</td>
<td>8.354</td>
<td>0.001*</td>
</tr>
<tr>
<td>(S/BC))Residual</td>
<td>54</td>
<td>773.772</td>
<td></td>
<td></td>
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<tr>
<td><strong>Total</strong></td>
<td>59</td>
<td>729.794</td>
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* \(p < 0.05\)
Dependent Variable, Recall (First Analysis)
Interaction (AB). Organization/Visuals
Table of Means (X's)

<table>
<thead>
<tr>
<th>Taxonomic Organization</th>
<th>No Visual (B₁)</th>
<th>Visual (B₂)</th>
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</thead>
<tbody>
<tr>
<td>A₁</td>
<td>6.18</td>
<td>12.2</td>
</tr>
<tr>
<td></td>
<td>n = 20</td>
<td>n = 20</td>
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<tr>
<td>Schematic Organization</td>
<td>A₂</td>
<td></td>
</tr>
<tr>
<td>A₂</td>
<td>14.33</td>
<td>11.25</td>
</tr>
<tr>
<td></td>
<td>n = 20</td>
<td>n = 20</td>
</tr>
<tr>
<td>No Organization</td>
<td>A₃</td>
<td></td>
</tr>
<tr>
<td>A₃</td>
<td>7.23</td>
<td>11.19</td>
</tr>
<tr>
<td></td>
<td>n = 20</td>
<td>n = 20</td>
</tr>
</tbody>
</table>

S = Schematic Organization
T = Taxonomic Organization
N = No Organization

Figure 6
Organization x Visuals
Disordinal Interaction
Dependent Variable, Recall (First Analysis)
Interaction (BC) Visuals/Activity
Table of Means (X's)

<table>
<thead>
<tr>
<th>Activity (C₁)</th>
<th>No Activity (C₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>No Visual</td>
<td></td>
</tr>
<tr>
<td>B₁</td>
<td>14.35</td>
</tr>
<tr>
<td></td>
<td>n = 10</td>
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<td>Visual</td>
<td></td>
</tr>
<tr>
<td>B₂</td>
<td>12.38</td>
</tr>
<tr>
<td></td>
<td>n = 20</td>
</tr>
</tbody>
</table>

Figure 7
Visuals X Activity
Ordinal Interaction
Dependent Variable, Recall (Second Analysis)
Interaction (BC) _Visuals/Activity
Table of Means (X's)

<table>
<thead>
<tr>
<th></th>
<th>Activity (C₁)</th>
<th>No Activity (C₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Visual (B₁)</td>
<td>14.30, n = 10</td>
<td>4.18, n = 10</td>
</tr>
<tr>
<td>Taxonomic Visual (B₂)</td>
<td>12.53, n = 10</td>
<td>10.88, n = 10</td>
</tr>
<tr>
<td>Schematic Visual (B₃)</td>
<td>15.05, n = 10</td>
<td>6.35, n = 10</td>
</tr>
</tbody>
</table>

Figure 8
Visuals x Activity
Ordinal Interaction
CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This chapter consists of the summary, conclusions, and recommendations. The summary restates the problem, describes the experimental design, describes the subjects and stimulus materials, and the instructional procedures and sequence of treatment and measurement. The findings are reported and the conclusions based upon the findings are established. Recommendations are made for further research as well as to teachers, teacher educators, and textbook publishers.

Restatement of the Problem

Little is known about the factors which affect comprehension of technical textual discourse. This study was designed to investigate this problem area.

Taxonomical and schematic organization were the two partially developed theories which provided some hypotheses that needed to be tested. The problem was comprehension of technical textual discourse. The researcher identified several factors related to the problem: (1) organization of text similar to that of memory structure; (2) presentation of visuals for the purpose of organization of memory and text; and (3) execution of an enactive performance for the purpose of aiding comprehension in consideration of the technical aspects of the presentation. This study was designed to identify which, if any, of
these factors had any effect upon the comprehension of technical textual discourse.

**Experimental Design**

Fisher's completely randomized three factor design was used as the statistical design, and Campbell and Stanley's (1963) posttest-only control group was the experimental design. The three independent variables were organization of text (A), visual (B), and enactive performance (C). There were three levels of the organization variable: (1) taxonomy, (2) schema, and (3) none. The visual variable was broken down into two levels: (1) visual or (2) no visual. The enactive performance variable had two levels, (1) activity and (2) no activity. The two measures of the dependent variables were the cloze procedure test and the free recall test. The cloze test was used to obtain two measures from each subject. It was scored twice, once for verbatim responses, and once for synonymous responses.

**Subjects**

One-hundred and forty seventh and eighth graders from the junior high division of Manteo High School, Manteo, North Carolina were used as subjects. Each subject was randomly assigned to a treatment group using a table of random numbers. The random assignments lead to an n of 10, in each treatment group. All one-hundred-forty subjects' (N = 140) scores were used in the analysis of data.
Stimulus Materials

The three levels of variable A (organization) were oral text presentations, or in the case of Level 3 (none), no presentation. The taxonomic organization was a presentation of statements describing slip casting. This arrangement had no temporal organization and merely presented the facts. There was no sequential order to the statements describing slip casting.

The schematic organization had a very definite temporal arrangement except for the temporal order established in the schematic text. The information was identical to that of the taxonomic arrangement.

The passages had the same number of propositions and the same number of proposition combinations: 57 total propositions, 8 single predicate-multiple argument, 22 single predicate-single argument, and 27 multiple predicate-single argument. These presentations were orally presented by three-minute audio-tapes.

The visuals used were text coordinated. Each presentation, taxonomic and schematic, had a text coordinated visual which was used with one-half of the subjects. The visuals were graphic black and white line illustrations of the two types of passages, taxonomic and schematic. A one-minute audio-tape was used as an explanation of the visuals.

One-half of the subjects simultaneously completed an enactive performance of slip casting. This allowed the subjects the opportunity to perform the technical aspects of the presentations.
Instructional Procedures and Sequence of Treatment

Six teachers, one aide, and a group of senior helpers were briefed. Teachers were given a procedure outline to follow, lists of subjects for each phase of the experiment, and scripts of monologue when necessary. The senior students were used to monitor the transfer of students from room to room and the researcher served as overseer of the whole process.

During homeroom the subjects were given treatment assignments and told to report to a particular classroom (see Figure 5). The teachers checked to make sure everyone on their individual lists was present. Following the name checks the teachers began the experiment by playing three-minute audio-taped presentations. After the tapes, those receiving visuals were given a few seconds to look over the visuals. Following this, the explanatory tape orally took them through the visual. Those receiving no visuals put their heads on their desk quietly for one-minute. Following the visuals or rest period, the presentation tapes were played a second time for double exposure. The groups who received visuals kept the visuals throughout the second playing of the tapes. The subjects who received visuals were in different rooms from those who did not receive visuals, just as the taxonomic presentation groups were in different rooms from the schematic group presentations. Those students who received no presentations and no visuals were in separate rooms from those who received visuals only, and were allowed to play cards during the time allowed for presentations and visuals (see Figure 5).
Following these two phases of the experiment was the activity phrase. The teachers called out the names of the students who were to report to the room in which the activity took place. Those remaining received no activity treatment. They wrote stories on the history of their county.

**Measurement**

Criterion measures were obtained from two instruments: (1) paper/pencil free recall and (2) a cloze procedure test (see Appendix F). The cloze procedure was scored in two different ways. The first scoring was based on verbatim responses, and the second was based on idea or synonymous responses for the correct verbatim answers of the first scoring. Thus, the three measures obtained were verbatim cloze, idea cloze, and recall (see Chapter 4). The cloze reliability coefficients established by the Kuder-Richardson Formula 21 for the verbatim and synonym (idea) cloze were .95 and .97, respectively.

The measurement phase took approximately forty-five minutes. The first type of measurement was a free recall of the subjects' experiences. The time allowed was fifteen minutes. The cloze procedure test was the second type of measurement. The subjects were instructed to follow an audio-tape while taking the test. They were instructed to fill in the blank when the narrator said, "blank".

The recalls were scored first by an outside rater and then by the researcher. These ratings were independent of each other. An inter-rater reliability of .99 was established by a Pearson correlation.

**Findings**

It was necessary to perform two sets of analyses (discussed in Chapters III and IV). The first four results statements came from
the first set of analyses. The last two statements of results came from the second set of analyses. The first analysis was of Groups 1 through 14, collapsing over the two kinds of visuals (taxonomic and schematic) at the no presentation level of organization. The second analysis was performed on Groups 9 through 14 for the purpose of determining if there was a difference in the three types of visuals (taxonomic, schematic, and no visual) at the third level of organization (none), as well as the overall effect of visuals (taxonomic and schematic) over no visuals (see Figure 4). The alpha level was set at .05 for testing the hypotheses. The results were:

1. With regard to initial learning, there was a significant main effect of organization in the recall analysis, which had to be interpreted in terms of the disordinal organization and visual interaction. A conditional main effect statement was made. There was a significant difference between schematic and taxonomic organization only at the no visual level, and therefore, the first hypothesis was rejected. The analysis resulted in a significant difference between the three levels of organization, taxonomic, schematic, and none.

2. The second hypothesis, visuals versus no visuals, was rejected due to a significant visual main effect in the verbatim analysis. The data demonstrated that the visual group performed at a higher level than the no visual group.
3. The third hypothesis, activity vs. no activity, was also rejected. There was a significant activity main effect in the recall analysis which had to be interpreted in terms of the ordinal visual/activity interaction. The main effect statement was conditional. Activity groups produced higher scores than the no activity groups, but they were significantly different only at the no visual level.

4. The fourth hypothesis, that of possible organization, visual, and activity interactions, was rejected. Two significant interactions were evident in the recall analysis. An organization and visual interaction was significant. The disordinal interaction indicated that the difference was significant only at the no visual level. The second interaction which had significance was between visuals and activity. The interaction was ordinal; however, the difference was only significant at the no visual level.

5. A significant activity main effect was evident in the recall analysis of the second set of analyses and lead to a rejection of the third hypothesis, activity vs. no activity. Once again, the main effect was interpreted in terms of the visual/activity interaction. The interaction was ordinal; however, the difference between activity and no activity was significant only at the no visual level of variable (B).
6. The fourth hypothesis, that of possible organization, and visual, activity interactions, was rejected as well, when results of the recall analysis indicated that there was a significant visual/activity interaction. The interaction was ordinal and significant at the no visual level only.

Conclusions

The following conclusions are based on the findings conditional to the present study:

1. Schematic organization is superior to taxonomic organization and no textual presentation in teaching seventh and eighth graders information on slip casting. It increases comprehension for initial learning.

2. Visuals compared to no visuals are effective in increasing comprehension for the initial learning of the technical aspects of the slip casting presentations for junior high students.

3. Activity compared to no activity facilitates comprehension of the technical aspects of the textual presentations on slip casting at the seventh and eighth grade level.

Recommendations

Recommendations to Researchers

It is recommended that:

1. More studies focus on semantic and episodic memory structures. These studies should attempt to determine how and when these structures work independently and/or stimulaneously.
2. This study be replicated using subjects of the same grade level, but who are located in areas other than isolated, coastal, rural communities.

3. Similar studies be executed using subjects ranging in ages from early childhood to adulthood.

4. Each of the variables of text organization, visuals, and enactive performance be studied individually as well as in combination. Individual studies could lead to insight as to the effects these variables have on learning. Studies are needed which combine the use of two or more of the variables.

5. Similar studies be designed which attempt to determine which type of criterion measures are best in given situations.

6. Studies be considered for the purpose of establishing the psychological processes involved in understanding technical discourse. They should include what and/or how much is understood.

7. Similar studies be designed which involve the use of instructional sequences of greater duration.

Recommendations to Teachers and Teacher Educators

It is recommended that:

1. Teacher educators introduce within undergraduate and graduate courses ideas which stimulate interest to learn
about memory structure and how to make use of these structures in organizing technical discourse, as well as to encourage students to take courses outside the field of industrial arts which deal with the topic of comprehension.

2. Teachers study and apply the schematic approach to discourse organization, both in oral and written form.

Recommendations to Textbook Publishers

It is recommended that:

1. Publishers conduct research regarding the organization of discourse in their materials in print.

2. Publishers conduct research on the interaction of discourse organization and visuals.
APPENDIX A

Taxonomic Text
Transcript
THE FORMING PROCESS OF CASTING

Casting is a forming process in which standard stock, in liquid or semi-liquid form, is poured or pumped into the cavity (hollow space) of a mold or die. The outcome of this process is called a casting. Some examples of casting are jello molded salads, popsicles, ceramic figurines, and chocolate bunnies.

The shape of a casting depends on the shape of the cavity in the mold. One mold can be used to make dozens of one kind of casting. These molds are called permanent molds. A permanent mold is separated into parts. The parts are held by bands. Molds may also be made from sand and used just once. These are called one-shot molds. Several different mold sizes or shapes are often cast (filled) from one batch of stock.

The standard stock used for casting metal is called ingots or pigs. For plastic, the stock is in the form of powder or pellets (particles). The stock used for casting clay is slip which is made from powdered clay mixed with water into liquid form. To cast chocolate, metal, and plastic, the stock has to be melted. Slip is already a creamy liquid. It often has to be strained to remove any solid pieces that may be mixed in the liquid.

Castings harden in two basic ways. Solid stock that has to be melted (metal, plastic, and chocolate) goes through a cooling process in hardening. Liquid stock poured into molds made out of plaster undergoes an absorption process in which the mold absorbs the moisture out of the liquid,
leaving the clay to take the shape of the mold. The excess liquid remaining in the center of the cavity has to be poured out of the mold. The casting will be hollow (rather than solid). The clay has to harden. The finished casting can be taken out of the mold. The casting has the size, shape, and surface finish of the mold cavity in which it was made.
APPENDIX B

Schematic Text Transcript
Casting is a forming process, wherein the first step is to take standard stock, which usually comes in solid form, and change it to a liquid or semi-liquid form. Before metal solid stock, called ingots or pigs, can be cast, it must first be heated until it becomes liquid or semi-liquid. Before plastic, which is in the form of powder or pellets (particles) can be cast it must first be heated. The stock for ceramics, which is powdered clay mixed with water, a creamy liquid called slip, can be poured or pumped without heating it. Once the material is in fluid form, it is poured or pumped into the cavity of a mold or die.

For example, think about casting a ceramic figurine. Other examples are jello molded salads, popsicles, figurines, and chocolate Easter bunnies. Before pouring the stock, you must first have a mold which has a cavity the size and shape of the kind of figurine you want. You must use a permanent mold made of plaster so that the mold can be used over, one time after another, for every person. A permanent mold is separated into parts. Rubber bands often hold the parts together. If you were to use a one-shot mold made of sand, it would be destroyed in removing the casting. One-shot molds are used only once.

After acquiring a mold, the next step is to strain the slip to make sure that there are no solid pieces mixed in the liquid. Following the straining, the slip is then poured into the mold. Some of the clay will then take the shape of the walls of the cavity as the mold absorbs moisture from the slip. After the clay forms to the walls of the cavity and is as
thick as desired, the excess liquid is emptied out of the mold. Otherwise, the casting will not be hollow (as a hollow chocolate bunny). It would be solid.

A casting is removed from a one-shot mold by breaking the mold. A casting can be removed from a permanent mold by separating the two sides. First, however, remove the rubber bands. A casting takes the size, shape, and surface finish of the mold cavity in which it was made.
APPENDIX C

Taxonomic Visual
and
Tape Transcript

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THE FORMING PROCESS OF CASTING

Standard Stock

- jello
  - powder
- metal
  - ingots
  - pigs
- plastic
  - powder
  - pellets
- clay
  - slip
- chocolate
  - powder

Forming

Casting

- permanent molds
- one-shot molds

- pouring
- pumping
- straining
- liquifying
  - melt
  - mix
- hardening
  - cooling
  - absorbing
- removing
  - break one-shot mold
  - open pieces of permanent mold
Visual - The Forming Process of Casting

Casting is a forming process. The material used for casting is standard stock. Several types of standard stock are: jello which is in the form of powder; metal which is in the form of ingots or pigs; plastic which is in the form of powder or pellets; clay which is in the form of slip; and chocolate which is also in powder form. In forming castings, two types of molds are used. They are permanent molds and one-shot molds. One-shot molds are made of sand. Permanent molds made of plastic can be used over and over again. One-shot molds are destroyed when removing a casting. It can be used only once. There are several steps in the process of casting. One pours or pumps the liquid into the mold. Some liquids have to be strained to make sure that there are no solid pieces mixed in the liquid. For example, slip often has to be strained. Solid stock has to be liquified. To become liquid one could either melt or mix solid stock. Liquid stock is poured into molds made of plaster. The moisture is absorbed out of the liquid by the mold. This allows the clay to form to the shape of the cavity of the mold as it hardens. Another way of hardening is for cooling to occur as with chocolate or plastic. To remove a casting from a permanent mold, one must open the pieces of the mold. To remove a casting from a one-shot mold, one must break the mold.
APPENDIX D

Schematic Visual and Tape Transcript
BEGIN WITH:

Standard Stock
(some of which are)
- metal
  - ingots
  - pigs
- plastic
- powder
- pellets
- clay
- slip

may be processed by

Forming

Casting
- permanent molds
- one-shot molds

which involves

One kind of forming is

Liquefying
- melting
- pouring

Straining

Pouring or Pumping

Hardening
- cooling
- absorbing

removing
- break one-shot mold
- open pieces of permanent mold

Finished Casting
(a ceramic figurine)
Visual - Casting A Ceramic Figurine

When casting one begins with standard stock. Standard stock comes in the form of metal, ingots or pigs; plastic, powder or pellets; and clay, slip. To cast a ceramic figurine, one would use the standard stock used for casting clay which is slip. Standard stock may be processed by forming. One kind of forming is casting. When casting, two types of molds can be used. One is a permanent mold made of plaster which can be used over and over again. The other is a one-shot mold made of sand which is destroyed when removing a casting. It can be used only once. Casting involves several steps. The first step is to liquify. This means one must either melt or mix the stock to make it liquid. The second step is to strain the slip to make sure that there are no solid pieces of clay mixed in the liquid. After straining, the third step is to pour or pump the slip into the permanent mold. The fourth step is to allow the plaster mold to absorb moisture from the liquid slip. This means that the clay will form to the walls of the cavity of the mold as it becomes hard. Another way of hardening would be cooling as chocolate or plastic would have to do. Finally, the last step is to remove the casting from the permanent mold separating the pieces of the mold. If one had used a one-shot mold they would have to break it to remove the casting. The process ends with a ceramic figurine as the product.
APPENDIX E

Proposition Combination
List
and
Propositional Breakdown of
Text Sentences
1s process, casting
forming, process
first, step
take, stock
standard, stock
solid, form
usually comes, stock, form
change, stock, form
form, liquid
form, semi-liquid
1t process, casting
forming, process
pour, stock
pump, stock
standard, stock
Loc: into cavity
mold, cavity
die, cavity
hollow, space, cavity
2t casting, outcome
process, casting
3t salad, casting
popsicle, casting
figurine, casting
bunny, casting
molded, salad
jello, salad
clay, figurine
chocolate, bunny
casting, examples
some, examples
2s metal, stock
solid, stock
ingots, stock
pigs, stock
before, cast, stock
first, heat, stock
becomes, stock, liquid
becomes, stock, semi-liquid
10t standard, stock
metal, stock
ingots, stock
pigs, stock
cast, stock
11t plastic, stock
powder, stock
pellet, stock
particle, stock
plastic, form
powder, form
pellet, form
particle, form
12t use, stock
cast, clay
slip, stock
make, stock, form
liquid, form
mix, stock, clay, water
3s before, cast, plastic
cast, powder
cast, pellets
cast, particles
first, heat, plastic
heat, powder
heat, pellets
heat, particles
13t cast, stock
melt, stock
chocolate, stock
metal, stock
plastic, stock
4s ceramic, stock
creamy, stock
liquid, stock
slip, stock
mix, stock, clay, water
powder, clay
pour, stock
pump, stock
no, heat, stock
14t already, liquid, slip
creamy, liquid
9t cast, sizes, batch
cast, shapes, batch
stock, batch
one, batch
different, sizes
different, shapes
several, sizes
several shapes
mold, sizes
mold, shapes
5s time, once
fluid, material
pour, material
loc: into cavity
pump, material
loc: into cavity
hollow space, cavity
mold, cavity
cavity, die
think, example
think, figurine
clay, figurine
think, cast
cast, figurine
before, pour, stock
first, have, you mold
have, mold, cavity
size, cavity
shape, cavity
want, you, cup
kind, cup
depends, shape, cavity
casting, shape
mold, cavity
use, mold
make, casting
one, mold
dozens, casting
kind, cast ng
one, kind
must use, you, mold
permanent, mold
plaster, mold
time: one time after another
use, person, mold
each, person
your, group
use, mold, group
permanent, molds
separated, mold, parts
permanent, mold
a, mold
often, hold, parts, bands
together, bands
rubber, bands
if, use, you, mold
one-shot, mold
sand, mold
destroy, mold
remove, casting
rather, than use, you, mold
permanent, mold
make, mold
sand, mold
use, mold
once, mold
one-shot, molds
once, use, mold
one-shot, mold
after, acquire, mold
next, strain, slip
strain, step
no, mix, pieces, liquid
solid, pieces
often, strain, slip
remove, pieces
solid, pieces
mixed, pieces, liquid
may be
following, strain, slip
then, pour, slip, mold
then, take, clay, walls
some, clay
cavity, walls
cavity, shape
absorbs, mold, moisture
Loc: from slip
pour, stock, molds
plaster, mold
undergoes, stock, process
absorbs, mold, moisture
take, clay, shape
harden, clay
harden, castings, ways
two, ways
basic, ways
solid, stock
metal, stock
plastic, stock
chocolate, stock
melt, stock
goes, stock, process
cooling, process
hardening, process
after, form, clay, walls
cavity, walls
empty, liquid, mold
Loc: out
thick, clay
desired, clay
remains, liquid, center
excess, liquid
cavity, center
pour, liquid, mold
Loc: out
otherwise, not, hollow, casting
bunny, casting
chocolate, bunny
hollow, bunny
hollow, casting
not, solid, casting
solid, it
remove, casting
break, mold
one-shot mold
Loc: from mold
divided, mold, parts
permanent, mold
two, parts
a, mold
remove, casting
a, casting
separate, sides
two, sides
Loc: from, mold
permanent, mold
take, casting, mold
finished, casting
Loc: out
takes, casting, cavity
made, casting
size, cavity
shape, cavity
finish, cavity
surface, finish
mold, cavity
has, casting, size
has, casting, shape
has, casting, finish
cavity, size
cavity, shape
cavity, finish
mold, cavity
surface, finish
made, casting, cavity
Loc: in
check, container
white, container
a, container
screened, container
check, stick
stir, stick
check, slip
cup, slip
check, mold
check, towels
paper, towels
see, you
have, you, container
have, you, stick
have, you, slip
have, you, mold
have, you, towels
rubber, bands
stir, slip
strain, slip
pour, slip
Loc: into the screened
container
the, slip
the, slip
will go, slip
Loc: through the screen
remove, screen
the, screen
Loc: from the container
put, parts
two, parts
Loc: together
the, parts
put, mold
Loc: together
place, bands
Loc: around the mold
the, bands
rubber, bands
pour, slip
Loc: into the mold
the, slip
fill, mold
completely, fill
the, mold
leave, slip
Loc: in the mold
time: until
get, edges
thick, edges
quarter, thick
a, quarter
the, edges
stick, slip
Loc: edges where
the, slip
begins, stick
Loc: to the sides of the
cavity
10a pour, slip
Loc: out of the mold
the, slip
Loc: back into the container
excess, slip
11a let, casting
Loc: inside the mold
let, harden
the, casting
12a remove, bands
Loc: from the mold
rubber, bands
the, bands
13a gently, separate
separate, parts
the, parts
separate, mold
the, mold
14a remove, casting
Loc: from mold
1. Casting is a forming process in which standard stock, in liquid or semi-liquid form, is poured or pumped into the cavity (hollow space) of a mold or die.

   (process, casting)
   (forming, process)
   (pour, stock)
   (pump, stock)
   (standard, stock)

   (Loc: into cavity)

   (mold, cavity)
   (die, cavity)
   (hollow, space, cavity)

2. The outcome of this process is called a casting.

   (casting, outcome)
   (process, casting)

3. Some examples of casting are jello molded salads, popsicles, clay figurines, and chocolate bunnies.

   (salad, casting)
   (popsicle, casting)
   (figurine, casting)
   (bunny, casting)

   (molded, salad)
   (jello, salad)

   (clay, figurine)
   (chocolate, bunny)

   (casting, examples)
   (some, examples)

4. The shape of a casting depends on the shape of the cavity in the mold.

   (depends, [shape, cavity])
   (casting, shape)
   (mold, cavity)
5. One mold can be used to make dozens of one kind of casting.

(use, mold)
(make, casting)

(one, mold)
(dozens, casting)
(kind, casting)
(one, kind)

6. The molds are called permanent molds.

(permanent, molds)

7. Molds may also be made from sand and used just once.

(make, mold)
(sand, mold)
(use, mold)
(once, mold)

8. These are called one-shot molds.

(one-shot, molds)

9. Several different mold sizes or shapes are often cast (filled) from one batch of stock.

(cast, sizes, batch)
(cast, shapes, batch)

(stock, batch)
(one, batch)

(different, sizes)
(different, shapes)

(several, sizes)
(several, shapes)

(mold, sizes)
(mold, shapes)
10. The standard stock used for casting metal is called ingots or pigs.

    (standard, stock)
    (metal, stock)
    (ingots, stock)
    (pigs, stock)
    (cast, stock)

11. For plastic, the stock is in the form of powder of pellets (particles).

    (plastic, stock)
    (powder, stock)
    (pellet, stock)
    (particle, stock)
    (plastic, form)
    (powder, form)
    (pellet, form)
    (particle, form)

12. The stock used for casting clay is slip which is made from powdered clay mixed with water into liquid form.

    (use, stock)
    (cast, clay)
    (slip, stock)
    ([make, stock] form)
    (liquid, form)
    (mix, stock, clay, water)

13. To cast chocolate, metal, and plastic, the stock has to be melted.

    (cast, stock)
    (melt, stock)
    (chocolate, stock)
    (metal, stock)
    (plastic, stock)
14. Slip is already a creamy liquid.
   (already, [liquid, slip])
   (creamy, liquid)

15. It often has to be strained to remove any solid pieces that may be mixed in the liquid.
   (often [strain, slip])
   (remove, pieces)
   (solid, pieces)
   (mixed, pieces, liquid)
   (may be)

16. Castings harden in two basic ways.
   (harden, castings, ways)
   (two, ways)
   (basic, ways)

17. (solid, stock)
   (metal, stock)
   (plastic, stock)
   (chocolate, stock)

   (melt, stock)
   (goes, stock, process)
   (cooling, process)
   (hardening, process)

18. Liquid stock poured into molds made out of plaster undergoes an absorption process in which the mold absorbs the moisture out of the liquid, leaving the clay to take the shape of the mold.
   (pour, stock, molds)
   (plaster, mold)
   (undergoes, stock, process)
   (absorbs, mold, moisture)
   (take, clay, shape)
19. The excess liquid remaining in the center of the cavity has to be poured out of the mold.

20. The casting will be hollow (rather than solid).

21. The clay has to harden.

22. The finished casting can be taken out of the mold.

23. The casting has the size, shape, and surface finish of the mold cavity in which it was made.
(cavity, size)
(cavity, shape)
(cavity, finish)

(mold, cavity)
(surface, finish)

(made, casting, cavity)

(Loc: in)
1. Casting is a forming process, wherein the first step is take standard stock, which usually comes in solid form, and change it to a liquid or semi-liquid form.

(process, casting)
(forming, process)
(first, step)
(take, stock) (standard, stock)
(solid, form)
(usually comes, stock, form)
(change, stock, form)
(form, liquid)
(form, semi-liquid)

2. Before metal solid stock, called ingots or pigs, can be cast, it must first be heated until it becomes liquid or semi-liquid.

(metal, stock)
(solid, stock)
(ingots, stock)
(pigs, stock)

(before [cast, stock])
(first [heat, stock])
(becomes, stock, liquid)
(becomes, stock, semi-liquid)

3. Before plastic, which is in the form of powder or pellets (particles) can be cast, it must also be heated as a first step.

(before [cast, plastic])
(cast, powder)
(cast, pellets)
(cast, particles)

(first, [heat, plastic])
(heat, powder)
(heat, pellets)
(heat, particles)

4. The stock for ceramics, which is powdered clay mixed with water, a creamy liquid called slip, can be poured or pumped without heating it.
5. Once the material is in fluid form, it is poured or pumped into the cavity (hollow space) of a mold or die.

   (time, once)
   (fluid, material)

   (pour, material) (loc: into cavity)
   (pump, material) (loc: into cavity)

   (hollow space, cavity)
   (cavity, mold)
   (cavity, die)

6. For example, think about casting a clay figurine.

   (think, example)
   (think, figurine)
   (clay, figurine)
   (think, cast)

   (cast, figurine)

7. Before pouring the stock, you must first have a mold which has a cavity the size and shape of the kind of cup you want.

   (before [pour, stock])
   (first [have, you mold])

   (have, mold, cavity)
   (size, cavity)
   (shape, cavity)

   (want, you, cup)
   (kind, cup)
8. You must use a permanent mold made of plaster so that the mold can be used over, one time after another, for each person in your group.

(must use, you, mold)
(permanent, mold)
(plaster, mold)

time: one time after another

(use, person, mold)
(each, person)
your, group
(use, mold, group)

9. A permanent mold is separated into parts.

(separated, mold, parts)
(permanent, mold)
(A, mold)

9a. Rubber bands often hold the parts together.

(often, hold, parts, bands)
(together, bands)
(rubber, bands)

10. If you were to use a one-shot mold made of sand, rather than the permanent mold, it would be destroyed in removing the casting.

(If [use, you, mold])
(one-shot [mold])
(sand, mold)
(destory, mold)
(remove, casting)
(rather than use, you, mold]
(permanent, mold)

11. One-shot molds are used only once.

(once [use, mold])
(one-shot, mold)
12. After acquiring a mold, the next step is to strain the slip to make sure that there are no solid pieces mixed in the liquid.

\begin{itemize}
\item \textit{after [acquire, mold]}
\item \textit{next [strain, slip]}
\item \textit{strain, step}
\item \textit{no [mix, pieces] liquid}
\item \textit{solid, pieces}
\end{itemize}

13. Following the straining, the slip is then poured into the mold.

\begin{itemize}
\item \textit{Following [strain, slip]}
\item \textit{then [pour, slip, mold]}
\end{itemize}

14. Some of the clay will then take the shape of the walls of the cavity as the mold absorbs moisture from the slip.

\begin{itemize}
\item \textit{then [take, clay, walls]}
\item \textit{some, clay}
\item \textit{cavity, walls}
\item \textit{cavity, shape}
\item \textit{absorbs, mold, moisture}
\end{itemize}

\textit{Loc: from slip}

15. After the clay forms to the walls of the cavity and is as thick as desired, the excess liquid is emptied out of the mold.

\begin{itemize}
\item \textit{after [form, clay, walls]}
\item \textit{cavity, walls}
\item \textit{empty, liquid, mold}
\end{itemize}

\textit{Loc: out}

\begin{itemize}
\item \textit{thick, clay}
\item \textit{desired, clay}
\end{itemize}
16. Otherwise, the casting will not be hollow (as a hollow chocolate bunny).
   (otherwise [not (hollow, casting)])
   (bunny, casting)
   (chocolate, bunny)
   (hollow, bunny)

17. It would be solid.
   (solid, It)

18. A casting is removed from a one-shot mold by breaking the mold.
   (remove, casting)
   (break, mold)
   (one-shot mold)
   (Loc: from mold)

19. A permanent mold is divided into two parts.
   (divided, mold, parts)
   (permanent, mold)
   (two, parts)
   (A, mold)

20. A casting can be removed from a permanent mold by separating the two sides.
   (remove, casting)
   (a, casting)
   (separate, sides)
   (two, sides)
   (Loc: from, mold)
   (permanent, mold)

21. A casting takes the size, shape, and surface finish of the mold cavity in which it was made.
(takes, casting, cavity)
(made, casting)

(size, cavity)
(shape, cavity)
(finish, cavity)
(surface, finish)
(mold, cavity)
APPENDIX F

Activity Instruction
Transcript
1. Check to see if you have a white screened container, stir stick, cup of slip, mold, and paper towels.

(check, container)
(white, container)
a, container)
(screened, container)
(check, stick)
stir, stick)
(check, slip)
cup, slip)
(check, mold)
(check, towels)
paper, towels)
(see, you)
(have, you, container)
have, you, stick)
have, you, slip)
have, you, mold)
(have, you, towels)

2. Stir the slip.

(stir, slip)

3. Strain the slip by pouring the slip into the screened container.

(strain, slip)
pour, slip)
(Loc: into the screened container)
the, slip)

4. The slip will go through the screen. Any large pieces will remain on top of the screen.

(the, slip)
(will go, slip)
(Loc: through the screen)

5. Remove the screen from the container.

(remove, screen)
the, screen)
(Loc: from the container)

6. Put the two parts of the mold together and place the rubber bands around the mold.

(put, parts)
two, parts)
(Loc: together)
the, parts)
(put, mold)
(Loc: together)
7. Pour the slip into the mold.

(pour, slip)
(Loc: into the mold)
(the, slip)

8. Completely fill the mold.

(fill, mold)
(completely, fill)
(the, mold)

9. Leave the slip in the mold until the edges, where the slip begins to stick to the sides of the cavity, get as thick as a quarter.

(leave, slip)
(Loc: in the mold)
(time: until)
(get, edges)
(thick, edges)
(quarter, thick)
(a, quarter)
(the, edges)
(stick, slip)
(Loc: edges where)
(the, slip)
(begins, stick)
(Loc: to the sides of the cavity)

10. Pour the excess slip out of the mold back into the container.

(pour, slip)
(Loc: out of the mold)
(the, slip)
(Loc: back into the container)
(excess, slip)

11. Let the casting harden inside the mold.

(let, casting)
(Loc: inside the mold)
(let, harden)
(the, casting)

12. Remove the rubber bands from the mold.

(remove, bands)
(Loc: from the mold)
(rubber, bands)
(the, bands)
13. Gently separate the parts of the mold.

(gently, separate)
(separate, parts)
(the, parts)
(separate, mold)
(the, mold)

14. Remove casting from mold.

(remove, casting)
(Loc: from mold.)
APPENDIX G

Criterion Measures
Casting is (a) _______ forming process, wherein (the) _______ step is to take (standard)____ stock, which usually comes (in)____ solid form, and change (it)____ to a liquid or (semi-liquid) form. Before metal solid (stock)____, called ingots or pigs, (can)____ be cast, it must (first)____ be heated until it (becomes) liquid or semi-liquid. Before (plastic)____, which is in the (form)____ of powder or pellets (particles)____ can be cast it (must)____ first be heated. The (stock)____ for ceramics, which is (powdered)____ clay mixed with water, (a)____ creamy liquid called slip, (can)____ be poured or pumped (without)____ heating it. Once the (material)____ is in fluid form, (it)____ is poured or pumped (into)____ the cavity of a (mold)____ or die.

For example, (think)____ about casting a ceramic (figurine)____. Other examples are jello (molded)____ salads, popsicles, figurines, and (chocolate)____ Easter bunnies. Before pouring (the)____ stock, you must first (have)____ a mold which has (a)____ cavity the size and (shape)____ of the kind of (figurine)____ you want. You must (use)____ a permanent mold made (of)____ plaster so that the (mold)____ can be used over, (one)____ time after another, for (every)____ person. A permanent mold (is)____ separated into parts. Rubber (bands)____ often hold the parts (together)____. If you were to (use)____ a one-shot
mold made (of) sand, it would be (destroyed) in removing the casting. (One-shot) molds are used only (once) ______.

After acquiring a mold, (the) next step is to (strain) the slip to make (sure) that there are no (solid) pieces mixed in the (liquid). Following the straining, the (slip) is then poured into (the) mold. Some of the (clay) will then take the (shape) of the walls of (the) cavity as the mold (absorbs) moisture from the slip. (After) the clay forms to (the) walls of the cavity (and) is as thick as (desired), the excess liquid is (emptied) out of the mold. (Otherwise), the casting will not (be) hollow (as a hollow (chocolate) bunny). It would be (solid).

A casting is removed (from) a one-shot mold by (breaking) the mold. A casting (can) be removed from a (permanent) mold by separating the (two) sides. First, however, remove (the) rubber bands. A casting (takes) the size, shape, and (surface) finish of the mold (cavity) in which it was (made).

Casting is a forming (process) in which standard stock, (in) liquid or semi-liquid form, (is) poured or pumped into (the) cavity (hollow space) of (a) mold or die. The (outcome) of this process is called a casting. Some examples (of) castings are jello molded (salads), popsicles, ceramic figurines, and (chocolate) bunnies.
The shape of (a) _________ casting depends on the  
(____shape)____ of the cavity in (the) ________ mold. One mold can  
(be)____ used to make dozens (of) ________ one kind of casting.  
(These)____ molds are called permanent (molds)________. A permanent  
mold is (separated)____ into parts. The parts (are)_______ held by  
bands. Molds (may)____ also be made from (sand)____ and used just once.  
(These)____ are called one-shot molds.  
(Several)____ different mold sizes or (shapes)____ are often cast  
(filled)____ (from)____ one batch of stock.  
(The)________ standard stock used for (casting)____ metal is  
called ingots or (pigs)_____. For plastic, the (stock)____  
is in the form (of)_______ powder or pellets (particles).  
(The)_____ stock used for casting (clay)_______ is slip which  
is (made)____ from powdered clay mixed (with)____ water into  
liquid form. (To)_______ cast chocolate, metal, and (plastic),  
the stock has to (be)____ melted. Slip is already (a)____ creamy liquid. It often (has)_____ to be strained to  
(remove)_____ any solid pieces that (may)_______ be mixed in the  
(liquid)____.  

Castings harden in two (basic)____ ways. Solid stock that  
(has)____ to be melted (metal, (plastic)____, and chocolate)  
goes through (a)_______ cooling process in hardening.  
(Liquid)_____ stock poured into molds (made)____ out of plaster  
undergoes (an)____ absorption process in which (the)____  
mold absorbs the moisture (out)______ of the liquid, leaving
(the) ___ clay to take the ___(shape)___ of the mold. The ___(excess)___ liquid remaining in the ___(center)___ of the cavity has ___(to)___ be poured out of ___(the)___ mold. The casting will ___(be)___ hollow (rather than solid). ___(The)___ clay has to harden. ___(The)___ finished casting can be ___(taken)___ out of the mold. ___(The)___ casting has the size, ___(shape)___, and surface finish of ___(the)___ mold cavity in which ___(it)___ was made.
Casting is a forming (process) in which standard stock, (in) liquid or semi-liquid form, (is) poured or pumped into (the) cavity (hollow space) of (a) mold or die. The (outcome) of this process is called a casting. Some examples (of) castings are jello molded (salads) popsicles, ceramic figurines, and (chocolate) bunnies.

The shape of (a) casting depends on the (shape) of the cavity in (the) mold. One mold can (be) used to make dozens (of) one kind of casting. (These) molds are called permanent (molds). A permanent mold is (separated) into parts. The parts (are) held by bands. Molds (may) also be made from (band) and used just once. (These) are called one-shot molds. (Several) different mold sizes or (shapes) are often cast (filled) (from) one batch of stock.

(The) standard stock used for (casting) metal is called ingots or (pigs). For plastic, the (stock) is in the form (of) powder or pellets (particles).

(The) stock used for casting (clay) is slip which is (made) from powdered clay mixed (with) water into liquid form. (To) cast chocolates, metal, and (plastic), the stock has to (be) melted. Slip is already (a) creamy liquid. It often (has) to be strained to (remove) any solid pieces that (may) be mixed in the (liquid).
Castings harden in two (basic) ways. Solid stock that (has) to be melted (metal, (plastic), and chocolate) goes through (a) cooling process in hardening. (Liquid) stock poured into molds (made) out of plaster undergoes (an) absorption process in which (the) mold absorbs the moisture (out) of the liquid, leaving (the) clay to take the (shape) of the mold. The (excess) liquid remaining in the (center) of the cavity has (to) be poured out of (the) mold. The casting will (be) hollow (rather than solid). (The) clay has to harden. (The) finished casting can be (taken) out of the mold. (The) casting has the size, (shape), and surface finish of (the) mold cavity in which (it) was made.

Casting is (a) forming process, wherein the (first) step is to take (standard) stock, which usually comes (in) solid form, and change (it) to a liquid or (semi-liquid) form. Before metal solid (stock), called ingots or pigs, (can) be cast, it must (first) be heated until it (becomes) liquid or semi-liquid. Before (plastic), which is in the (form) of powder or pellets (particles) can be cast, it (must) first be heated. The (stock) for ceramics, which is (powdered) clay mixed with water, (a) creamy liquid called slip, (can) be
poured or pumped (without) heating it. Once the (material) is in fluid form, (it) is poured or pumped (into) the cavity of a (mold) or die.

For example, (think) about casting a ceramic (figurine). Other examples are jello (molded) salads, popsicles, figurines, and (chocolate) Easter bunnies. Before pouring (the) stock, you must first (have) a mold which has (a) cavity the size and (shape) of the kind of (figure) you want. You must (use) a permanent mold made (of) plaster so that the (mold) can be used over, (one) time after another, for (every) person. A permanent mold (is) separated into parts. Rubber (bands) often hold the parts (together). If you were to (use) a one-shot mold made (of) sand, it would be (destroyed) in removing the casting. (One-shot) molds are used only (once).

After acquiring a mold, (the) next step is to (strain) the slip to make (sure) that there are no (solid) pieces mixed in the (liquid). Following the straining, the (slip) is then poured into (the) mold. Some of the (clay) will then take the (shape) of the walls of (the) cavity as the mold (absorbs) moisture from the slip. (After) the clay forms a (the) walls of the cavity (and) is as thick as (desired), the excess
liquid is (emptied) out of the mold. (Otherwise), the casting will not (be) hollow (as a hollow (chocolate) bunny). It would be (solid).

A casting is removed (from) a one-shot mold by (breaking) the mold. A casting (can) be removed from a (permanent) mold by separating the (two) sides. First, however, remove (the) rubber bands. A casting (takes) the size, shape and (surface) finish of the mold (cavity) in which it was (made).
APPENDIX H

Synonym List
1. **process** -- technique, method, procedure
2. **in** -- comes in, is in
3. **is** -- are, that, is
4. **the** -- a, an, one, the mold
5. **a** -- the, an, one
6. **outcome** -- result, end, consequence, product, ending, remains
7. **of**
8. **salads**
9. **chocolate** -- Easter
10. **a** -- the, this, your
11. **shape** -- form, size
12. **the** -- a, each, it's, your
13. **be**
14. **of**
15. **these** -- the, a, you, some plaster, some
16. **molds**
17. **separated** -- divided, torn, broken, split, taken apart, cut, opened
18. **are** -- is, of the mold are
19. **may, can**
20. **sand** -- dirt, soil
21. **these** -- some molds, some, they, those
22. **several** -- many, some, other
23. **shapes** -- forms, figures, kinds, cavities
24. **from** -- by, with
25. **the** -- some, one, a, metal
26. casting -- molding
27. pigs
28. stock -- plastic, material
29. of
30. the -- standard, this, a
31. clay -- ceramics
32. made -- formed, derived, mixed
33. with -- in, by, from
34. to
35. plastic
36. be -- have
37. a -- like, a (nice and), in a, made into
38. has -- needs, is
39. remove -- take out, get rid of, catch, keep, get, stop, get out, separate, 
   eliminate, prevent, strain
40. may -- might, can, could
41. liquid -- mixture, slip, batch, clay, stock, mix
42. basic -- different, main
43. has -- needs, is, had
44. plastic
45. a -- an, the, standard, this
46. liquid
47. made -- formed, that come, is
48. an -- a, the, that
49. the -- a, your
50. out -- from all
51. the -- some, hard,
52. shape -- form, formation, side
53. excess -- leftover, extra, rest of, remaining, unused, unhardened, last of the, other, creamy, wet.
54. center -- middle, hole, inside, hollow, inner, space, pocket
55. to
56. the -- a, your
57. be -- remain, stay, become, turn, then
58. the -- your, this
59. the -- a, your
60. taken -- pulled, took, removed, flipped
61. the -- a, your, this
62. shape -- form, look
63. the -- a, each
64. it -- casting
65. a -- the
66. first
67. standard
68. in -- as
69. it -- the stock, (standard/solid), the solid form
70. semi-liquid
71. stock -- material
72. can -- could, is, to, may, should
73. first
74. becomes -- is, became, forms, reaches, turns (into)
75. plastic
76. form -- state
77. particles -- fragments
78. must -- has to
79. **stock** -- standard stock, material, mixture
80. **powdered** -- dry
81. **a** -- the
82. **can** -- could, must, may
83. **without**
84. **material** -- standard stock, clay, slip, ceramic, stock, mixture
85. **it** -- slip
86. **into** -- in
87. **mold** -- form
88. **think** -- learn
89. **figurine** -- object, thing, item
90. **molded** -- mold
91. **chocolate**
92. **the** -- your, some, standard
93. **have** -- take, get, find, use, pick, choose
94. **a** -- the (a large?)
95. **shape**
96. **figurine** -- object, thing
97. **use** -- have, find, get, take, choose
98. **of** -- from, with
99. **mold** -- shape, form, cast
100. **one** -- another
101. **every** -- each, another, other, more
102. **is** -- could be, can be, must be, would be, may be
103. **bands** -- pieces, ties
104. **together**
105. **use** -- have, take, get, make
106. **of** -- from, out of, with
107. **destroyed** -- broken, smashed, broke
108. **one-shot**
109. **once** -- one time
110. **the** -- a, your
111. **strain** -- screen, sift
112. **sure** -- certain
113. **solid** -- hardened, large, big, clump(y), broken, extra, loose, lumpy, huge
114. **liquid** -- slip, stock, clay, ceramic, mixture, mix
115. **slip** -- clay, liquid, stock, mix, mixture, mud
116. **the** -- a, your
117. **clay** -- slip, stock, liquid, mud, mixture
118. **shape** -- form, forming
119. **the** -- a
120. **absorbs** -- takes out, dries up, removes, traps, draws, collects, sucks, soaks, pulls, get
121. **after** -- then, next
122. **the** -- all of the
123. **and** -- until, it
124. **desired** -- a quarter, you want
125. **emptied** -- poured drained, dumped, removed, pumped, taken
126. **otherwise**
127. **be** -- become, stay
128. **chocolate** -- Easter
129. **solid** -- hard, filled
130. from -- out of
131. breaking -- destroying, crushing, smashing, busting, cracking
132. can -- may, could, would
133. permanent
134. two -- separate, different
135. the -- your
136. takes -- is, has
137. surface
138. cavity -- hole, center, form, shape
129. made -- form, cast
APPENDIX I

Table of Treatment Means and Standard Deviations (Groups 1-14)
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Groups 9-15 Isolated

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APPENDIX J

Tukey Formula
and
Scheffé Formula
Tukey

\[ \hat{\psi}_{(hsd)} = q(a) - \sqrt{\text{ms}(S/A)/n} \]

Scheffé

\[ F = \frac{\hat{\psi_i}^2}{(a-1)(\frac{1}{n_i} + \frac{1}{n_j})\text{MS}(S/A)} \]

(Kennedy, 1977)
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