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A COMPARATIVE STUDY OF VISUALLY DIRECTED METHODS AND TOPICS USING THREE PICTURE-PASSAGE FORMATS

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A COMPARATIVE STUDY OF VISUALLY-DIRECTED METHODS AND TOPICS USING THREE PICTURE-PASSAGE FORMATS

By

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ABSTRACT

A COMPARATIVE STUDY OF VISUALLY-DIRECTED METHODS AND TOPICS USING THREE PICTURE-PASSAGE FORMATS

By

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This study had three purposes. First, the study attempted to find out whether a simultaneous presentation of pictures and passages, as exemplified by a set of stationary and manipulative boards, would be more conducive to learning than a successive presentation of pictures and passages, as exemplified by a set of booklets. Second, the study attempted to find out whether the manipulative boards, which required the students to position the pictures above their appropriate passages, would be more conducive to learning than the stationary boards, which presented the pictures already mounted above their appropriate passages. Third, the study attempted to find out whether a topic of higher interest would be more conducive to learning than a topic of lower interest for each of the treatments: booklets, stationary, and manipulative boards.

A convenient sample of 180 fifth-grade students were randomly assigned to two independent variables: three methods (booklets, stationary, and manipulative boards) and two topics (Chimps and Indians). Each student was as-

signed to a single method and topic.

Achievement posttests were the major instruments. Each test (Chimps and Indians) was divided into two dependent variables: passage and picture content items. In terms of validity, both tests conformed to the same structural specifications: that is, both had the same number of items, set of learning objectives, and reading levels. In terms of reliability, both tests achieved similar and high reliability coefficients and mean indices of discrimination.

The following conclusions were derived from the MANOVA and ANOVA tests of significance: (1) The simultaneous presentations (boards) were more conducive to learning both higher and lower interest topics, in terms of picture content, than the successive presentation (booklet); (2) The manipulative boards were not more conducive to learning a higher or lower interest topic than the stationary boards; and (3) The topic of higher interest (Chimps) was more conducive to picture and passage learning, for each of the three methods, than the topic of lower interest (Indians). Based on the conditions and findings of this study, it would appear that students could achieve higher levels of learning if they were given more simultaneous (multiple-image) presentations.

DEDICATION

I dedicate this dissertation to my wife and parents. Without their constant inspiration, confidence, and love, I could not have conducted this research.

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CHAPTER I

IDENTIFICATION OF THE PROBLEM

This chapter discusses the following topics: Need for the Study: Theoretical Bases; Statement of the Problem; Significance of the Study; and Limitations of the Study. It also includes a statement of the Research and Statistical Hypotheses.

Need for the Study: Theoretical Bases

It is generally accepted by educators and others in instructional design that pictures and words combined offer a more powerful mnemonic strategy than either pictures or words alone. Recently, there has been an increasing amount of research designed to examine this relationship. Most of the studies (e.g., Paivio, 1970; Rohwer, 1970; Levin, 1976) support the contention that pictures are more concrete than words and that picture/word combinations are more concrete and powerful than either words or pictures. While the majority of studies have focused on simple paired-associate tasks for younger children, a limited number of studies (e.g., Koenke & Otto, 1969; Rusted & Coltheart, 1979; Haring & Fry, 1979) have paired pictures with prose passages for older children. In

general, the results have substantiated the claim that pictures facilitate passage comprehension.

Mediation theory helps to support visual-verbal associations by asserting that the images stimulated by both items in a paired-associate task become incorporated into a compound image which increases the associate connection between the two items. As an adjunct to mediation theory, Paivio's (1971) dual-coding hypothesis proposes two separate memory systems, a left hemisphere for verbal processes and a right hemisphere for imagery processes. While words may only be coded in one hemisphere, pictures are frequently coded in both hemispheres thus making images easier to recall.

Piaget's (1971) child developmental theory asserts that older children, after they enter the concrete operations stage, acquire a more functional and dynamic kind of imagery which is transformational and manipulative. Piaget's learning stages support a developmental hypothesis which states that older children have a greater capacity than younger children to develop spontaneous verbal labels for pictures. This implies that older children may learn relatively more than younger children from pictorial presentations.

Travers and Alvarado (1970) state that "Research has established that, as the child grows older, his capability of handling complex stimuli and his preference for interpreting the material as a whole increase" (p. 54).

"A related finding is that humans show a preference for viewing visual displays that have some complexity to them. Such a preference is shown at a very early age" (p. 58). "The preference for complexity shown by children in the older age groups and by adults is also related to the increased capacity to handle perceptual complexity that comes with age" (p. 59).

Perrin (1969) asserts that multiple-image presentation may be valuable for presenting comparisons and showing relationships. "The immediacy of this kind of communication allows the viewer to process larger amounts of information in a very short time" (p. 369). A variety of learning principles, including simultaneity, proximity, and repetition among others, would appear to favor a simultaneous presentation of pictures and passages as opposed to a succession of pictures and passages. Fleming and Levie (1978) state that "Presenting examples in close succession or simultaneously in small groups, and keeping previous examples in view while others are added facilitate concept acquisition" (p. 179).

A simultaneous display of pictures and passages may be used to strengthen the proximity of the elements. The principle of proximity states that "Other things being equal, units that are closer together will tend to be perceived as part of a single entity" (Rock, 1975, p. 254). This ability to see the parts as a single entity is a

child developmental process according to Piaget and Inhelder (1956). By about the age of nine, the child develops a capacity to handle complex stimuli and a preference for integrating the material as a whole.

If a set of pictures and passages are displayed throughout the instructional period, this condition encourages and facilitates repeated eye movements. "Therefore, it appears that the primary reason that recognition is better following long exposures is that subjects have more time to make multiple fixations during the exposure" (Goldstein, 1975, p. 57). This observation is a variation on Thorndike's Law of Frequency; that is, learning is influenced by the frequency with which the stimuli are encountered. Loftus (1972) measured eye fixations and found that the more fixations a person makes on a picture, the higher the probability that he will correctly recognize it later.

While a booklet usually places the questions at the end of the article, it is convenient to place the question sheet in front of the simultaneous visual display. This arrangement emphasizes the principle of contiguity; namely, events that occur close together and provide direct and immediate response are more likely to be associated and remembered.

The organizational properties of a simultaneous visual display are enhanced by strong vertical and hori-

zontal lines, figure-ground relationships, and by familiar directionality (i.e., left to right and top to bottom). "Where material to be learned is organized and that organization is apparent to the learner, acquisition will be facilitated" (Fleming & Levie, 1978, p. 132). Furthermore, these organizational properties will be reinforced and accented if the display elements are presented simultaneously and continuously.

Piaget (1956) and Bruner (1966) maintain that the tactual mode is the forerunner of the visual mode, and that visual processes are built on knowledge acquired tactually. As the child grows older, according to Piaget (1971), his ability to coordinate and combine information from different sensory modalities also matures. Thus, even though there is a shift to the visual mode at about age seven, overt activities and kinetic manipulations help to facilitate dynamic imagery and sentence production. "More learning can occur where information is received concurrently in two modalities, e.g., vision and audition or vision and touch, than where received in only one modality" (Fleming & Levie, 1978, p. 107).

Studies of younger children generally support the learning principle of multisensory stimuli (e.g., tactual and visual). However, in the case of older children, there is insufficient research and the findings are inconclusive. Silverston and Deichmann (1975) assert that

"No conclusions regarding the contribution to tactile and kinesthetic modality dynamics to the reading process can be derived" (p. 162). Raskin and Baker (1975) suggest that "Teachers may begin with visual presentation and proceed to add touch and other modalities until the appropriate approach is found for the individual child" (p. 51).

The research on children's picture style preferences (Sloan, 1972; Lucas, 1977; Myatt & Carter, 1979) indicates that older children clearly prefer realistic photographs to other types of illustrations. They also prefer multicolors over black-and-white or a single color. Travers and Alvarado (1970) report that the use of color facilitates the perception of the dynamic features. As children grow older, they become capable of reporting on the dynamic features of the presentation (p. 56). Furthermore, children show a preference for viewing visual displays (e.g., a set of related pictures with ongoing scenes) that have some complexity to them (p. 58).

The research on children's reading preferences (Norvell, 1958; Ashley, 1970) shows that animals are one of the most popular topics for all elementary grades and for both sexes. The topic of "animals" is consistently more popular than "people of long ago" or related topics in social studies.

Surprisingly, there is a limited amount of research on the relationship of children's reading interest

to reading comprehension. Two recent studies (Asher, Hymel, & Wigfield, 1978; Asher, 1979) show that fifth graders, of both sexes and different races, comprehend more high- than low-interest reading material.

Statement of the Problem

This study was designed to provide research based on three areas of concern and inquiry. First, the study attempted to find out whether a simultaneous presentation of pictures and passages, as exemplified by the stationary and manipulative boards, would be more conducive to learning than a successive presentation of pictures and passages, as exemplified by the booklets. Second, the study attempted to find out whether the manipulative boards, which required the students to position the pictures above their appropriate passages, would be more conducive to learning than the stationary boards, which presented the pictures already mounted above their appropriate passages. Third, the study attempted to find out whether a topic of higher student interest would be more conducive to learning than a topic of lower student interest for each of the treatments: booklets, stationary, and manipulative boards.

Significance of the Study

This study has several important dimensions for educators and instructional designers. First, while pic-

ture-passage combinations are frequently used in a variety of instructional formats, little is known about the comparative effectiveness of these presentations. While the principles of proximity, repetition, organization, simultaneity, etc., appear to support a simultaneous presentation of pictures and passages, little is known about the instructional effectiveness of this technique. Perrin's (1969) theory of multiple-image communication "...suggests that for making contrasts and comparisons, and for learning relationships, simultaneous images reduce the task of memory (a dimension of visual task) and enable the viewer to make immediate comparisons" (p. 376). Even though the case for simultaneous and multiple-image displays is supported by a substantial array of learning principles and child developmental theory, the preponderant amount of visual-verbal instruction follows the traditional textbook format. (While the quality and quantity of textbook pictures have generally improved in recent years, the pictures are often given a minor role and picture-passage cues are frequently missing.) Unfortunately, very little is known about the instructional merit of a successive book(let) presentation as opposed to a simultaneous display presentation. Since the researcher could not find any research which attempted to compare these methods, it would appear that this study will be breaking new ground.

Second, since most paired-associate paradigms have

concentrated on simple picture-word tasks for younger children, there is a need to investigate the effectiveness of more complex picture-passage combinations for older children. As Fleming (1977) observes, "...most of the work (pictorial research) has been done with very simple pictures and paired-associate tasks, neither of which are adequately representative of school learning" (p. 46). While picture-word tasks are important to a young child, the larger portion of his elementary education will concentrate on more sophisticated pictures and passages and, regrettably, the combined strength may be overlooked. Thus, this study should provide some important data by applying a multivariate analysis of the picture and the passage retention. Even in those studies concerned with picture-passage learning, the treatment and testing stages are frequently unrepresentative of the usual classroom environment. For example, the child(ren) may be given a special set of directions and then treated and tested individually by a pretrained instructor. This study tries to minimize the unrepresentative elements by presenting self-contained materials which minimize the need for special directions or assistance.

Third, it is important to find out whether multisensory (i.e., visual-tactual) learning will prove more beneficial to older children than single modality (i.e., visual) learning, given the conditions in this study.

This data will be derived from a comparison of the stationary and manipulative boards and based on the picture and the passage posttest results. The researcher has been unable to locate a single study in which a tactual variable has been tested using simultaneous displays of pictures and passages with older children. While the tactual experience of sorting and positioning pictures may add concreteness to the lesson, will it actually produce more retention and concept development than an identical set of pictures already attached to a display board? While many studies indicate the advantages of multisensory learning for younger children, older children have been largely overlooked in these investigations. Therefore, this study could make a significant contribution to visual-tactual research at the upper elementary level.

Finally, it is important to determine whether the amount of interest children express for different topics will influence the degree of success associated with a successive and/or simultaneous picture-passage format. Some important questions need to be investigated. For example, if children express a higher interest for a given topic, will they tend to learn more regardless of the format or only with a particular format? Would a lower interest topic benefit more from a visual-tactual format than a pure visual format? More research on these questions could help educators and instructional designers

match the appropriate topic interest to the proper picture-passage format(s).

Recent studies (Asher, Hymel, & Wigfield, 1978; Asher, 1979) have shown that high topic interest leads to greater reading comprehension. In the case of this study, even if a child's high topic interest facilitated his passage retention, would it also increase his picture retention or vice versa? While this single study cannot provide definitive answers to the important questions it raises, it may provide some valuable indications.

In summary, the data collected from this study should be helpful in designing and presenting visually-directed materials, especially with simultaneous presentations of pictures and passages. Perhaps even more significantly, this research may help to determine the merit of using alternative formats to supplement the usual textbook approach.

Limitations of the Study

The results of this study were circumscribed, in terms of generalizability, by several considerations. First, the fifth grade subjects were drawn from convenient classrooms and not randomly sampled from the total school district population of Lansing, Michigan. The generalizability was further restricted to a middle to lower middle working class, urbanized, and racially integrated population.

Second, although the literature reviewed did not limit the definition of multiple-image presentations to a still set of pictures and passages on stationary and manipulative surfaces, the specific media used in this study did represent restricted samples. While there was a scarcity of literature on visual-tactual learning at the fifth grade level, the specific materials and type of manipulation called for in this study did place limitations on its generalizability. Since the methods and topics were specifically designed for this experiment, their specifications had to be taken into consideration. For example, before generalizing the results of this study, it was important to specify the number, size, and content of the pictures and passages, along with the board dimensions.

Finally, the results of this study were also limited by the nature of the instrumentation. Each method and topic was tested by a multiple-choice posttest based on passage and picture content. The administration of the posttests called for cued, written, and delayed recall. The researcher chose a single test instrument (multiple-choice format), as opposed to more than one objective test form, because it could provide a consistent measurement of the passage and picture content within the limited scope of the topics. Furthermore, the 50 item multiple-choice tests were carefully designed to encompass the most important concepts covered by the topics.

Research and Statistical Hypotheses

Three research hypotheses were derived from the need for the study and the significance of the study. The first two hypotheses were based on the methods and the third hypothesis was based on the topics.

First, the mean scores associated with the stationary board group and the manipulative board group were each expected to exceed the mean score associated with the booklet group. This expectation applied to both dependent variables: passage and picture content.

Second, the mean score associated with the manipulative board group was expected to exceed the one associated with the stationary board group. This expectation applied to both dependent variables: passage and picture content.

Third, the mean score associated with the topic of higher interest (Chimps) was expected to exceed the one associated with the topic of lower interest (Indians) for each of the methods. This expectation applied to both dependent variables: passage and picture content.

This study was based on three statistical hypotheses. For the purpose of testing, they were stated in the null form.

1. There would be no difference in the means of the booklet group versus the stationary and manipulative board groups in regard to the dependent variables: passage

and picture content.

2. There would be no difference in the means of the stationary board group versus the manipulative board group in regard to the dependent variables: passage and picture content.

3. There would be no difference in the means of the two topic groups (Chimps versus Indians) in regard to the dependent variables: passage and picture content.

To reject a null hypothesis, the test required a significant difference for at least one of the dependent variables: passage and/or picture content. The alpha level was set at .05.

Summary

The first research hypothesis appeared to have substantial theoretical support. For example, it was noted that a variety of learning principles, including simultaneity, proximity, and repetition among others, appeared to support a simultaneous presentation of pictures and passages as opposed to a succession of pictures and passages. However, it was pointed out that very little is known about the instructional merit of a successive book(let) presentation as opposed to a simultaneous display presentation.

The theoretical support for the second research hypothesis was more tenuous than the first. According to the child developmental theory of Piaget, as the child

grows older, his ability to coordinate and combine information from different sensory modalities also matures. However, in the case of older children, there has been an insufficient amount of research regarding the contribution of tactual learning.

The third research hypothesis appeared to receive a reasonable amount of support based on topical studies of children's reading interests. Research on children's reading preferences has shown that "animals" are consistently more popular than "people of long ago" or related topics in social studies. However, it has not been determined whether the amount of interest children express for different topics will influence the degree of success associated with a successive and/or simultaneous picture-passage format.

It was pointed out that this study should be helpful in designing and presenting visually-directed materials, especially with simultaneous presentations of pictures and passages. It was argued that this research could help to determine the merit of using alternative formats to supplement the usual textbook approach.

CHAPTER II

REVIEW OF THE LITERATURE

This chapter includes the following topics: Imagery Development and Visual-Verbal Learning; Principles of Visual Perception and Learning; Sensory Modality Learning; Picture-Topic Preferences and Reading Comprehension; and Design Recommendations for Instructional Materials. They examine research pertaining to the research hypotheses.

Imagery Development and Visual-Verbal Learning

This topic includes the following subtopics: Imagery and Developmental Theory; Paired-Associate Learning; and Picture Facilitation of Passage Content. These subtopics present the rationale for picture-passage formats.

Imagery and Developmental Theory

While imagery has been subjected to a variety of definitions, this study will adhere to Fleming's (1977) description of imagery as "...an internal representation of such external events." Furthermore, "...it is a phenomenon of memory, i.e., the recalled image, reconstructed with varying fidelity from past experience" (p. 44). Images can be provided by the experimenter in the form of pictures (imposed images), or the learner can be instructed to generate his own images (induced images). Stimulus

and response images can be depicted in separate pictures (unelaborated) or can be depicted in an interactive scene (elaborated). In a review of imagery research, Pressley (1977) reports that "Pictures (imposed images) can increase children's prose learning if the pictures accurately depict information from the text." He concludes that "There is one fact about imagery and children's learning which is indisputably true: imposed pictures are almost always learned better than words" (p. 613).

Bruner (1966) argues that during cognitive development, the primary information source shifts from inactive or tactile/kinesthetic processes to iconic or visual processes. As the child grows older, these iconic processes shift to symbolic or language processes. This theory would seem to imply that pictures should not be the primary emphasis for older children since they might obstruct the symbolic processes. Piaget (1971) contends that when children enter the concrete operations stage (about 7 to 12 years of age), they acquire a more functional kind of imagery which is transformational and kinetic: characterized by dynamic change and movement. Thus, the older child is more adept at manipulating imposed and induced images than the younger child. Nelson (1971) observes that "The child's ability to recall, recognize, or reproduce previously presented information has been shown to improve with increasing age for a large and diverse set of tasks" (p. 346). In general, re-

search has supported a developmental hypothesis, based on Piaget's theory, which states that older children have a greater capacity than younger children to develop spontaneous verbal labels for pictures. This implies that older children may learn relatively more than younger children from pictorial presentations.

Paired-Associate Learning

The bulk of experimental research on picture-word relationships in children's learning has focused on paired-associate paradigms. For younger and older children alike, simple picture-word associations have shown that "Pictorially represented objects are more memorable than their associated verbal labels" (Levin, 1976, p. 106). This picture superiority has been documented in a number of studies (Reese, 1970, and Shepard, 1967) where children were required to recall or recognize previously exposed stimuli.

While most researchers in paired-associate learning usually attest to the mnemonic superiority of pictures over words, Anderson (1976) is reluctant to draw any definitive conclusions. He argues that it is difficult to interpret the relative effectiveness of words and pictures because it is virtually impossible to equate words and pictures on most psychological dimensions. "Picture superiority effects are ambiguous simply because the level of interitem similarity across form classes has not been equated" (p. 378).

Mediation theory contends that the images aroused by both items in a paired-associate task become incorporated into a compound image (relational association) which increases the associative connection between the two items. Stimulus imagery is especially important because, during the testing portion of the task, the stimulus acts as a cue (conceptual peg) which reinstates the image mediator and allows decoding of the response terms (Paivio, 1969). Many studies have supported Paivio's (1971) "Dual Coding Hypothesis" which asserts that there are two memory systems for recalling information: verbal processing and visual processing. Neurological testing (Sperry, 1964) has shown that these verbal and visual functions are identified with the left and right hemispheres of the brain. Paivio's "Dual Coding Hypothesis" states that pictures are easier to retrieve than words because pictures are frequently coded in both cerebral hemispheres while words are more apt to receive just a verbal coding.

Rohwer (1970) reports that picture-word pairs are superior to all other combinations (picture-picture, word-picture, and word-word pairs) for eliciting correct responses. Children "...should be taught the use of both verbal and visual kinds of elaborate activities" (p. 402). Rohwer recommends that "Whenever possible, items to be associated should be presented in some kind of meaningful linguistic context rather than as isolated terms, and, es-

pecially for older children, the items should be depicted in some kind of spatial relation, or involved in some kind of meaningful interaction" (p. 402).

Picture Facilitation of Passage Content

Some recent studies have focused on the influence of pictures on learning related prose passages. These experiments (e.g., Peeck, 1974; Levin & Lesgold, 1978; Peng & Levin, 1979) have shown that providing pictures to supplement narrative text improves the child's recall and comprehension of prose passages.* Peeck (1974) randomly assigned 71 fourth graders to either an experimental group (text with illustrations) or a control group (text without illustrations). The posttests were given at three different times: immediately, after four days, and after one week. The experimental group scored higher on the retention test, regardless of the time lapse, than the control group for questions concerning exclusively pictorial information and for questions concerning correctly illustrated text content. Subjects who read the illustrated text scored significantly higher than subjects who read the text

*It should be noted that these studies included different variables from this study: (1) While this study included multiple-image (simultaneous) formats, these studies involved textbook (successive) formats; (2) While this study involved expository passages, these studies were based on narrative passages; and (3) While this study was based on silent reading, delayed, and cued recall, two of these studies (Levin & Lesgold, 1978; Peng & Levin, 1979) did not involve these three variables.

without illustrations. The instrumentation involved multiple-choice items and cued recall.

Koenke and Otto (1969) conducted a study to determine the extent to which content relevant pictures contributed to children's comprehension of the main idea inherent in a printed passage. Ninety sixth grade students read three 200 word passages written on a fifth grade level. The students read the passages and viewed the pictures silently and then responded immediately to oral questions. Students who read passages accompanied by pictures responded with main ideas on a significantly higher level than students who did not see the passages. The researchers drew two conclusions from their findings: (1) When sixth grade students are told to discover the main ideas not explicitly stated in the passages, they look at the accompanying pictures to enhance their understanding of the main idea; and (2) "As long as pictures have general relevance to a topic, their presence is likely to enhance main idea responses even in the absence of explicit directions to attend to them" (p. 301).

In a study involving 64 fifth grade students, Odom and Nesbitt (1974) found that greater retention occurred when pictures and sentences were mutually cued to one another. This study was limited to a small sample and the pictures-sentences were reasonably simple and short. Rusted and Coltheart (1979) found that nine and ten year old children, of high and low reading ability, could recall

more prose passages when pictures were present. After reading aloud a set of 12 passages with accompanying animal pictures, the students relied on immediate and free-recall to test their retention. While the pictures enhanced the recall of prose passages, they had no effect on the recognition and pronunciation of novel words.

Haring and Fry (1979) observe that "Investigations of picture effects on comprehension of orally presented materials do not explore directly the effect of pictures on reading comprehension" (p. 185). They analyzed a prose passage into main ideas and nonessential details with corresponding pictures. Fourth and sixth grade students relied on free recall to write down all they could remember of the narrative (storybook) passages immediately and again five days later. The results found that pictures did facilitate both immediate and delayed recall. However, this finding was true for the main ideas but not for the nonessential details.

Principles of Visual Perception and Learning

This topic applies to the first research hypothesis; namely, that each board is expected to outscore the booklet. This topic includes the following subtopics: Visual Field and Multiple-Image Perception; Proximity and Similarity; Spatial Relations and Organization; Repetition and Exposure Time; and Whole and Simultaneous Presentation.

Visual Field and Multiple-Image Perception

The visual field is defined as that area or space we can see with our head and eyes held stationary. The visual field extends about 180 degrees laterally and 150 degrees vertically (Gibson, 1950).* Most of the information within the visual field, at a given moment, is subject to peripheral vision. According to Goldstein (1975), "When you look directly at the object, you are fixating that object and the image of that fixated object always falls on the fovea, the small area of the retina that is most sensitive to detail. Visual acuity, our ability to see detail, is high at the fovea but drops off rapidly as we move away from the fovea and towards the peripheral retina" (p. 37). Peripheral vision has the important function of integrating the pieces and providing a sense of continuity for a complex scene. "Although peripheral information is used to determine the next fixation, the target presently being fixated is also being analyzed. Thus, two tasks are being performed simultaneously" (Haber & Hershenson, 1980, p. 333).

Perrin (1969) states that multiple-image presentation may be valuable for presenting comparisons and showing relationships. This is especially true when the purpose

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*Figures 3.2 and 3.3, in chapter 3, illustrate how the stationary and manipulative boards fall within the visual field.

of the presentation is to present specific concepts and/or fairly technical information which are designed to be recalled later. "The immediacy of this kind of communication allows the viewer to process larger amounts of information in a very short time. Thus, information density is effectively increased, and certain kinds of information are more efficiently learned. For visual comparisons it seems axiomatic that simultaneous images are more effective than sequentially presented images" (p. 369). Of course, there are circumstances which might mitigate or even negate this theory, such as an overload of images or an overly rapid presentation.

Haber and Hershenson (1980) define scanning and how it relates to serial and parallel processing. Scanning "... describes the procedure of going systematically from one portion of an information field to the next, and then to the next, and so forth. When a field is scanned, each item is treated in turn. This is called serial processing. An alternative procedure processes all the items of information at once. This is called parallel processing" (p. 294). It would appear that a multiple-image presentation could take advantage of both serial and parallel processing, especially if the viewer is given selective directions. While the viewer's initial contact might elicit some parallel processing to integrate the parts, a set of directions could produce serial processing by isolating parts and comparing subsets.

It would appear that a set of multiple-images could help the learner to compare sizes, shapes, and distances. Kennedy (1974) observes that when we examine pictures, "We actually use relative size, not absolute size. Only when we compare the depicted object with other objects in the same scene can we know its size" (p. 67). According to Piaget (1971), comparing objects and relationships is essential to the intellectual process at the concrete operations stage. In Bloom's (1956) taxonomy of cognitive thinking skills, the ability to establish logical relationships is identified as the "analysis level." It is a forerunner to the uppermost levels of synthesis and evaluation.

Proximity and Similarity

Proximity and similarity belong to the Gestalt laws of perceptual organization. The Gestalt laws govern the segregation of the perceptual field into separate forms which are most stable or which create a minimum of stress. The principle of proximity states that "Other things being equal, units that are closer together will tend to be perceived as part of a single entity" (Rock, 1975, p. 254). The closer together we arrange the images, the stronger are the forces of attraction. This principle facilitates comparisons in terms of similarities and differences. Forgus (1966) notes that proximity and similarity are usually difficult to separate in practice. If their effect is in a common direction, they tend to strengthen one another.

"Proximity gains further significance because it is not only a stimulus condition for perception but also in learning, though under a different label, namely contiguity. Events that occur close together, i.e., that are contiguous, are considered likely to become associated or learned" (Fleming & Levie, 1978, p. 71).

The principle of similarity says that groups may be formed from elements that are similar to one another. This principle may be utilized to group or organize objects in a variety of ways, including appearance, function, direction, content, and even color. Gould (1976) observes that "Color provides a good cue for subjects to perform grouping operations on figure-background relations, whereas shape or size of objects evidently are not as effective. More generally, color coding is an effective means for people to locate targets quickly" (p. 324).*

Rock (1975) observes that "Before proximity can regulate perceptual organization, a certain amount of processing of information concerning spacing must first occur. The objective distance between units in space must first be perceived and only then does relative proximity among such units determine grouping" (p. 283). This statement leads to spatial relations and organization.

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*In this study, the Chimpanzee pictures are unified by cool colors and the Cave Indian pictures are unified by warm colors.

Spatial Relations and Organization

Spatial relations and organization are interdependent and their principles complement each other. Spatial relations are designed to influence the perception of relationships. According to Fleming and Levie (1978), they frequently depend on such factors as proximity, inclusion, directionality, superordination, and accentuation. Proximity has already been discussed in some detail. As an example of inclusion, a display board could be used to delineate the boundaries for sets of pictures and passages. In the case of directionality, a set of visuals may be numbered in a familiar order, such as left-to-right and top-to-bottom. Superordination may be achieved by placing the pictures above the passages in a stimulus position. Accentuation may be achieved by the mutual cuing and reinforcement between the materials.

Spatial relations have a strong affinity for vertical and horizontal lines. Forgus (1966) states that "The main coordinates of two-dimensional space are the gravitational vertical and the horizontal which is perpendicular to it. These two planes constitute the main frame of reference against which we ordinarily judge spatial direction that is located in two dimensions" (p. 185). As a principle of perception, Fleming and Levie (1978) state that "Horizontals and verticals are perceptually special, i.e., in contrast to oblique orientations of line and pattern,

they are more intense (evoke more activity in the visual cortex of the brain), are more readily compared (similarities and differences more apparent) and more accurately judged for spatial orientation" (p. 36). While a vertical and horizontal orientation may be applied to a variety of visual formats, a multiple-image presentation is a powerful device for accenting these coordinates.

Figure-ground relationships are critical to spatial relations and organization. The principle of surroundedness means that the inner region is usually regarded as the figure while the surrounding region is viewed as the ground. Fleming and Levie (1978) state that the figure is perceived as having internal unity and solidity while the ground is less definitely defined and appears behind the figure. "A given contour can belong to only one of the areas it bounds and shapes, and whichever side it shapes will be perceived as figure" (p. 42). The most distinctive figures have closed and continuous contours.

Studies have shown, according to Gould (1976), "...that people fixate on contours much more frequently than they fixate on homogeneous areas of a picture. This is true, of course, because contours carry more information than do homogeneous areas, as both information theorists and visual neurophysiologists have pointed out" (p. 326). Kennedy (1974) points out that perception consists, to a large extent, on how clearly the figure emerges from the

ground. If the contour lines are indistinct and fail to clearly outline the relevant from the irrelevant features, the information will be difficult to interpret and may even be lost. Since a simultaneous visual format may focus on a set of related images, it is in a position to accent the figure-ground relationships.

The aforementioned principles have stressed the importance of spatial relations and organization. "Organized presentations are generally easier to learn than unorganized or randomly ordered presentations, and thus interactive mental imagery (organized) would be expected to be better remembered than unorganized imagery" (Fleming, 1977, p. 48). As a principle of memory, Fleming and Levie (1978) state that "Where material to be learned is organized and that organization is apparent to the learner, acquisition will be facilitated" (p. 132).

Repetition and Exposure Time

These concepts are interdependent since greater exposure time allows for more repetition. Goldstein (1975) maintains that "Our perceptual system demands that an object be fixated if it is to be seen in detail; thus, if the purpose of a presentation is to present detailed information, then time must be allowed for the observer to fixate every relevant image at least once" (p. 59). Furthermore, "...if it is necessary that observers recall details of a particular picture, or a complex idea transmit-

ted by the picture, longer exposure times may be necessary" (p. 58).

Loftus (1972) conducted a study which found that the number of fixations a picture receives is a major factor in the subsequent memory for that picture. College students viewed 180 pictures while their eye movements were recorded. A recognition test indicated that as the number of fixations increased, the probability of picture recall also increased. There was little or no memory for pictures which were originally viewed only peripherally.

Research has shown that high-valued or high fidelity pictures receive more fixations and tend to be remembered better than low-valued pictures. It would appear that elaborated images, if viewed as a composite for an extended period of time, could reinforce picture fidelity and encourage repetitive fixations. Travers and Alvarado (1970) state that high fidelity pictures "...provide the viewer with much the same sensory input that he would have if he were viewing the actual scene represented by the pictures" (p. 49). Kennedy (1974) argues that pictures usually provide us with clear and precise information about "...objects and scenes that are not in our immediate surroundings" (p. 12).

Whole and Simultaneous Presentation

While these concepts are related to several of the aforementioned principles (such as proximity, similarity,

spatial relations, and organization), they warrant additional clarification and substantiation. Fleming and Levie (1978) have stated an important principle of learning to this study, "Presenting examples in close succession or simultaneously in small groups, and keeping previous examples in view while others are added facilitate concept acquisition" (p. 179).* Hochberg (1968) argues that cognitive expectancies play a major part in integrating a series of glimpses. The viewer generates a "schematic map" through which a succession of images are related and stored. These maps are a composite of what has already been seen and what is expected to be seen. This schematic mapping is particularly appropriate for successive presentations.

Kates and Yudin (1964) conducted a study of three instructional formats based on slides of geometric shapes without words or passages: (1) a successive presentation, in which one example was shown at a time; (2) a focus condition, in which two examples were presented together; and (3) a simultaneous presentation, in which each new example was shown with all the previous examples remaining in view. Simultaneous presentation was superior to the other two modes of presentation because the students did not have to rely upon memory from previous examples. Many studies have confirmed the superiority of a simultaneous presentation of learning ma-

*In this study, while the booklets provide for a close succession of images, the boards provide for simultaneous images for an extended time period.

terials in regard to sentence (Reynolds, 1968) and picture (Baumeister, 1979) acquisition.

Research has shown that when different stimuli are presented simultaneously to each eye, only one stimulus is usually seen at a time. This condition is referred to as "retinal rivalry." This poses a problem when the pictures are presented in rapid succession. "While it is not strictly possible to see two things at once, nearly simultaneous vision can be accomplished by rapidly switching attention from one part of the visual field to another with eye and head movements" (Goldstein, 1975, p. 51).

Piaget and Inhelder (1956) maintain that older children, by the age of about nine, are capable of integrating the parts into a whole. The child develops a capacity to handle complex stimuli and a preference for interpreting the material as a whole. Travers and Alvarado (1970) contend that older children and adults show a preference for viewing more complex visual displays which may be interpreted as ongoing scenes. Fleming and Levie (1978) report two perceptual principles concerned with complexity and balance: (1) "Attention is drawn and held by complexity, providing the complexity does not exceed the perceivers' cognitive capacities; and (2) In directing our attention, we seek a balance between novelty and familiarity, between complexity and simplicity, between uncertainty and certainty" (pp. 22, 25).

Sensory Modality Learning

This topic applies to the second research hypothesis; namely, the mean score associated with the manipulative board group is expected to exceed the one associated with the stationary board group. This topics includes the following subtopics: Child Developmental Growth; Paradigms Based on Sensory Modalities; Studies Based on Sensory Modalities; and Principles of Multimodal Learning.

Child Developmental Growth

Both Piaget (1956) and Bruner (1966) argue that sensory functioning is the foundation for the development of knowledge. Bruner maintains that the tactual mode is the forerunner to the visual mode and, furthermore, that visual processes are built on knowledge acquired tactually. Piaget contends that directional awareness and spatial orientation, which are basic to success in reading, are based on early integration of tactual and visual cues.

Both Piaget and Bruner recognize that young children shift from inactive (tactile/kinesthetic) to iconic (visual) processes. Bruner argues that this transition is an improvement over the limited inactive stage which precedes it but which must be outgrown. If the inactive stage is not outgrown, it becomes an obstacle to further development. While Piaget (1958) also recognizes this natural transition in early childhood development, from the tactual modality to a preference for visually dominated be-

havior at about age 7, he feels, unlike Bruner, that the motor (tactual) influence should continue to have an important role in intellectual growth. Piaget (1971) emphasizes the important emergence of intersensory coordination. The child becomes increasingly capable of coordinating and combining information from the different sensory modalities as he grows older. The concrete operations stage produces a more dynamic and anticipatory imagery which involve movement of objects in space or transformations of stationary objects. Thus, overt activities and kinetic manipulations are not obsolete, according to Piaget, but are expected to facilitate dynamic imagery and sentence production.

Paradigms Based on Sensory Modalities

There are three sensory modalities most frequently used in instruction: the visual, auditory, and tactual. Most of the research deals with one or a combination of these sensory paradigms: intramodal, intermodal, and multimodal. In the intramodal condition (also known as intrasensory transfer), a child learns a task using one modality and then is tested on a similar task using the same modality. In the intermodal condition (also known as intersensory transfer), the child learns a task in one modality and then is tested for retention using a different modality. In the multimodal condition (also known as multisensory integration), two or more sensory systems, such as vision and touch, are integrated simultaneously. A task is presented

simultaneously and then the child is tested using either modality or a combination. Most studies have examined the intramodal and/or intermodal paradigms while little attention has been given to multimodal learning.*

Studies Based on Sensory Modalities

Only a small number of studies have actually investigated the influence of visual-tactual tasks on picture and/or passage retention for older children. Most of the research has been based on reading studies involving primary grade students. Silverston and Deichmann (1975) state that "The kinesthetic and tactile modalities have not been emphasized in the investigation of reading processes." Furthermore, "No conclusions regarding the contribution of tactile and kinesthetic modality dynamics to the reading process can be derived" (pp. 161-162).

Derevensky (1978) reports that "Investigations into the learning process and information processing have established that children learn to read through the auditory, visual, and kinesthetic (tactual) sensory modes. Yet there appears to be little unanimity on the degree of the relationship or the level of dependence of reading ability with respect to particular sensory modalities" (p. 10).

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*Multimodal learning is the closest paradigm to the manipulative board process used in this study.

Ford (1967) found that tactile-visual (intermodal) transfer was a predictor of reading achievement for 121 fourth grade boys from a middle-class suburban community. The study did not yield high correlations between tactual-visual performance and reading achievement. Ford states that "On the basis of certain theoretical and observational data there would be good reason to expect a relationship between tactual-visual abilities and educational achievement" (p. 839).

Bissell, White, and Zivin (1971) argue the merit of intersensory learning because "Information obtained through one modality comes to be related to and modified by ongoing activity in the others" (p. 135). As children grow older, their intersensory coordination enables them "...to integrate information obtained from the kinesthetic modality with information obtained from the visual modality" (p. 147). "The fact that the human mind is a composite system and that complete understanding involves understanding something through the various senses sug-guests that instruction based on the kinesthetic modality should be included at all levels of education, no matter how old the students" (p. 154). While Bissell, White, and Zivin express considerable confidence in intersensory integration, many other researchers would argue that the functional relationship between modalities is still very uncertain and requires future experimental designs.

Principles of Multimodal Learning

Raskin and Baker (1975) contend that research results have consistently shown that vision is the dominant and superior modality for all age groups and both sexes. As a general principle, the "Teachers may begin with visual presentation and proceed to add touch and other modalities until the appropriate approach is found for the individual child" (p. 51). "The best conclusion at this time is that vision is the mode of greatest accuracy for information gathering for normal, retarded, and learning disabled children. The question of the efficiency of multisensory training over a period of time is not yet answered" (p. 53).

As a memory principle, Fleming and Levie (1978) state that "More learning can occur where information is received concurrently in two modalities, e.g., vision and audition or vision and touch, than where received in only one modality" (p. 107). Fleming and Levie point out that "This principle only states a possibility, which numerous circumstances can negate. Conflicting information in two modalities can interfere with learning" (p. 107).

It should be noted that the visual-tactual findings and the aforementioned principles have been based on diverse variables which make it risky to draw inferences or state conclusions. For example, the studies vary from two to three dimensional materials, immediate to delayed

recall, and free to cued recall. Finally, the bulk of visual-tactual research has concentrated on simple paired-associate tasks which provide little insight into more sophisticated sets of interacting pictures and passages.

Picture-Topic Preferences and Reading Comprehension

This topic applies to the third research hypothesis; namely, the mean score associated with the topic of higher interest is expected to exceed the one associated with the topic of lower interest for each of the methods. This topic includes the following subtopics: Picture Characteristics and Preferences; Children's Topic Preferences; and Topic Interests and Reading Comprehension.

Picture Characteristics and Preferences

Knowlton (1966) defines three kinds of pictures: (1) Realistic pictures represent actual events and/or objects portrayed; (2) Analogical pictures represent either the phenomenal or nonphenomenal world; and (3) Logical pictures signify relationships between elements--maps, schematic drawings, etc. In the case of realistic pictures, according to Knowlton, "...if some scene in the visual world is of interest, a detailed realistic portrayal of it will often evoke something of the same positively valued response that is evoked by direct perception of the situation portrayed" (p. 177).

Duchastel (1978) suggests that textbook illustra-

tions may have three roles: attentional, explicative, and/or retentional. First, they may be designed to interest and motivate the reader. Second, they may help to explain a concept being made in the passage. Third, they may enhance the long-term recall of the prose. Duchastel explains that these roles are not mutually exclusive although trade-offs may enter into the process of deciding which role(s) to emphasize.

Whipple (1953) examined fourth-grade textbooks and found that picture preferences were based on several factors: including a definite center of interest, a scene of action, multicolors over black-and-white or a single color, and eventful as opposed to still-life topics. Lucas (1977) gathered data from basal readers on the illustrative preferences (i.e., realism, cartoon, abstract, impressionistic, photographic) of 521 fifth grade children. His findings showed that children tended to choose photographic styles for information articles. The study recommended that more photographs should be used in published materials, and that persons responsible for selecting illustrations should be given training in critical picture evaluation.

Myatt and Carter (1979) found that children of both sexes, in grades one thru six, preferred photographs to all other picture styles, including full line drawings (paintings included). Sloan (1972) also found that fifth

graders preferred photographs to realistic pictures (paintings included) with or without a story passage.

Children's Topic Preferences

A singularly comprehensive, longitudinal study on the reading interests of elementary students was conducted by Norvell (1958). The research spanned 25 years and included over 24,000 children in grades three thru six in schools of all sizes in New York State. A questionnaire was used with eight broad classifications. A category for "animal stories" was included but there was no clear category for "Indians" or a related topic. While Norvell's questionnaire could have provided a wider list of categories, the results did show that "animal stories" had the highest rating from boys and the second highest for girls after "girl's books."

A more recent study of children's reading interests was conducted by Ashley (1970). A representative sample of 900 elementary children in the intermediate grades were asked to indicate their likes and dislikes of 40 reading topics. There were 265 respondents at the fifth grade level. The collective data for both sexes showed that "real animals" was seventh on the popularity list and "life in the past" was sixteenth on the list.*

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*For the topics in this study, "real animals" was the closest topic to "Wild Chimpanzees" and "life in the past" was the closest topic to "Cave Indians."

Another study of children's reading interests was conducted by the Beta Upsilon Chapter (1974). A total of 405 ten and eleven year old students responded to a "reading interest form" which included 20 topic categories. The students chose "animals" and "mystery" as their favorite topics. The topic of "animals" was chosen by a four-to-one margin over "history" and by a three-to-one margin over "people."

In summary, the research clearly shows that "animals" is one of the most popular topics for all elementary school children and for both sexes. Topics from the area of social studies, such as early cultures, would appear to be less popular at the elementary level.

Topic Interests and Reading Comprehension*

Surprisingly, there is very little research on the relationship of pupil's topical interests and reading comprehension. This is probably due to the widely held assumption, by many educators, that there is a strong correlation between the two factors. Asher, Hymel, and Wigfield (1978) examined this relationship in a study involving 75 fifth grade children. Twenty-five color slides covering a wide range of topics, from monkeys to humans,

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*While the researcher found a small amount of research on the above topic, he could not locate any studies which attempted to examine the impact of children's topical interest on simultaneous picture-passage retention.

were used to assess student interests. The students were divided into high- and low-interest conditions and given cloze passages (paragraphs with fill in the missing words). An ANCOVA was used to prevent any potential confounding effects based on initial reading differences. The analysis indicated that the effect of interest was significant, with children comprehending more of high- than low-interest material. A second result showed that sex was not significant. Finally, the interaction of sex and interest was not significant because both sexes did better on the high-interest material.

In a study concerning the "Influence of Topic Interest on Black Children's and White Children's Reading Comprehension," Asher (1979) found that both races did significantly better on high- than low-interest material. Furthermore, an analysis of topic preferences indicated considerable cross-race similarity of interests. The study involved 66 fifth grade children in an integrated suburban school.

In summary, recent evidence indicates that children's reading comprehension is influenced by their level of interest in the topic material. Both sexes and races did better on high- than low-interest topic matter in the fifth grade.

Design Recommendations for Instructional Materials

This topic presents eight basic conditions/recommendations for designing and presenting educational materials.

Since this study tested three instructional formats (booklets, stationary, and manipulative boards), these conditions provide a criteria for evaluating the structure and presentation of the materials. While most of the conditions are especially relevant to the boards, with the exceptions of numbers two and eight, the majority also apply to the booklets. Since many instructional designers have expressed similar recommendations for designing educational materials, this section will limit itself to a few noted specialists.

Gayne and Rohwer (1969) have listed eight conditions by which the "manager of instruction may manipulate" the learning process (p. 382). Each of these conditions will be described in the succeeding paragraphs.

First, the instructional designer should "...employ techniques to gain and maintain the attention of the learner." It would appear that a simultaneous display, which accents the visual elements and their interrelationships, should capture the learner's attention. Knowlton (1966) observes that an "...important function of pictures in communication is to gain attention, arouse interest, or please esthetically" (p. 172).

Second, the designer should "...establish within the learner certain preconditions for learning by giving pretraining, by providing verbal directions, by stimulating recall." This condition implies that if the learner is familiar with the instructional process and materials, this

will tend to increase the achievement level. This condition could be accomplished by: (1) A comprehensive pretraining program designed to acquaint the subjects with the procedures and materials; and/or (2) A set of related lessons given to the same group of subjects over an extended period of time. Unfortunately, the researcher cannot adequately satisfy this condition when: (1) The topics and methods remain undisclosed prior to the treatment; and (2) Each subject is given a single lesson treatment.

Third, the instructional designer should "...present the stimuli directly involved in learning as actual objects and events, printed materials, or pictures, among other forms." This condition implies that the most concrete stimuli should be given a prominant position. Gropper (1966) "...suggests that positive transfer effects from one learning situation to another are more likely to be obtained when learning based on a visual experience precedes learning from a verbal experience than when the reverse order is followed" (p. 48). Gibson (1969) argues that the visual modality also takes precedence over the tactual modality. He argues that the recollection or discrimination of forms presented tactually and visually indicate the superiority of visual processes throughout development.

Fourth, the designer should "...aid the learning process by methods of prompting and guiding, often in the

form of verbal communications." In this condition, Gayne and Rohwer are calling for cuing devices to assist the learner. As Allen (1975) puts it, "Directing attention to relevant cues which emphasize material to be learned within an instructional communication may increase learning..." (p. 151). An elaborated display board, which combines and exhibits pictures, passages, and question sheets simultaneously, may serve as a multiple-cuing device. For example, the pictures and passages may be mutually cued and the question sheet may guide the student's attention to a particular picture or a set of contrasting pictures. Severin (1967) states that "Multi-channel communications which combine words with related or relevant illustrations will provide the greatest gain because of the summation of cues between the channels" (p. 243).

Fifth, the instructional designer should "...specify the conditions for responding as in the contrast between overt and covert responses." Along similar lines, Allen (1975) states that "The elicitation of an active response or engagement of the learner in active participation during the presentation of instructional material may increase the learning..." (p. 153). A question sheet may elicit an active response in the learner by directing him to locate and position several subsets of pictures on a display board. The question sheet may also direct the pattern of fixations and eye movements.

Sixth, the designer should "...employ methods to provide feedback to the learner concerning the correctness or incorrectness of his performance at various stages of learning." Most instructional designers would agree that immediate feedback is more beneficial to the learner than delayed feedback. For example, if the learner has just matched a set of pictures to a set of passages, an answer key should be immediately available to check the correctness of this activity. Furthermore, after locating key concepts to complete a set of sentences and choosing titles for sets of pictures, another answer key may be provided for self-correcting feedback.

Seventh, the instructional designer should establish "...conditions to promote retention, including such factors as repetition and rehearsal." In a previous topic based on principles of visual perception, it was asserted that a simultaneous and continuous display of multiple-images should facilitate repetition and retention. We may expect a multiple-image display to elicit repetitive eye movements based on serial and parallel processing. While serial processing tends to be systematic and on a conscious level, parallel processing tends to be more random and subliminal.

Eighth, the designer should "...use techniques which enhance the transfer of learning to subsequent learning tasks or other performances." When a study is

restricted to a single lesson treatment, it cannot begin to evaluate the transfer of learning which might result from subsequent tasks. Of course, the brevity of a study does not portend a basic weakness in the treatment formats per se. This matter of transfer learning, along with the pre-training condition raised by Gayne and Rohwer, will be discussed in the last chapter.

In addition to the aforementioned conditions, Allen (1975) has a suggestion concerning the organization of instructional materials. He states that "The structuring or organizational outlining of the content of an instructional communication may increase the learning of the content..." (p. 150). As an example of instructional organization, Wright, Gebhard, and Karttunen (1975) found that related pictures in a common context induced an uniform recall strategy and led to much better recall than presenting pictures as unrelated items. Their findings applied to various age groups ranging from elementary children to adults.

Summary

A review of the literature indicated that a variety of learning principles, including simultaneity, proximity, and repetition among others, appeared to support a simultaneous presentation as opposed to a successive presentation of pictures and passages. Thus, the research and theoretical bases provided a substantial amount of support for the first research hypothesis; namely, that each board mean

was expected to outscore the booklet mean, especially in terms of picture content.

While the instructional effectiveness of visual-tactual formats designed for upper elementary remains undetermined, child developmental theory appears to encourage multisensory learning. For example, Piagetian theory asserts that as the child grows older, his ability to coordinate and combine information from different sensory modalities also matures. Thus, the research and theoretical bases provided some, albeit inconclusive, support for the second research hypothesis; namely, that the manipulative board mean was expected to outscore the stationary board mean, especially in terms of picture content.

Research on children's reading preferences has shown that animal topics are consistently more popular than topics based on people or cultures of long ago for all elementary grades. Since a few recent studies have indicated that topics of high interest produce high reading comprehension, it appeared that the Chimps would outscore the Indians across all three methods. Thus, the literature provided a reasonable amount of support for the third research hypothesis; namely, that the higher interest topic mean would outscore the lower interest topic mean for both passage and picture content.

Since the primary purpose of this study was to test three instructional formats (booklets, stationary, and ma-

nipulative boards), the review of the literature concluded with eight basic conditions/recommendations for designing and presenting educational materials. While most of the conditions were especially relevant to the boards, the majority also applied to the booklets. In summary, these conditions provided additional rationale for the design and presentation of the instructional materials in this study.

CHAPTER III

METHODOLOGY AND DESIGN

This chapter includes the following topics: Research Questions; Population and Sample; Research Design; and Statistical Models of Analyses. The Research Design includes an extensive discussion of the instruments, independent variables, pilot studies, and design validity.

Research Questions

The following three research questions were derived from the statement of the problem and the review of the literature. The first two were based on the methods and the last one on the topics.

1. Given an identical set of pictures and passages in booklet form and on stationary and manipulative board surfaces, was there a difference in the effectiveness between the booklet and each of the boards?

2. Given an identical set of pictures and passages on stationary and manipulative board surfaces, was there a difference in the effectiveness between the two boards?

3. Given a topic of higher interest and a topic of lower interest, was the topic of higher interest more

effective for each of the methods?

Population and Sample

The sample for this study consisted of 180 fifth grade students from two elementary schools in the Lansing School District of Michigan. The Lansing School System included 41 elementary schools with over 13,700 students. The two schools selected for this study were chosen because of their convenient location; therefore, they were not chosen from a random sample. Since all of the Lansing schools were subjected to cluster busing and racial integration, the schools had a very uniform student population. The racial and ethnic composition included 64% White, 23% Black. 10% Latino, 2% Asian, and 1% American Indian.

Most of the students came from homes within the middle to lower middle income brackets. The population was largely working class and employed in jobs related to the auto industry. At the time of this study, there was a high rate of unemployment because of a recession in the automobile industry.

The fifth grade classrooms for this study were heterogeneous in ability levels. In the Lansing schools, there was no effort to group students according to their intelligence quotients on either an intra- or inter-school basis. Since the materials for this study were written close to grade level, most of the fifth grade students

were able to work comfortably with the treatments. A few students were excluded from the study because of serious reading and/or language problems.

Research Design

Basic Design Elements and Procedures

The overall design consisted of five basic elements. The elements included posttests and questionnaires, three treatments, two topics, MANOVA and ANOVA models, and a random sample.

1. Observations were based on a pair of achievement posttests: one based on Wild Chimps and the other on Cave Indians. These posttests were designed along parallel specifications for the purpose of comparing the two topics. Each test was analyzed in regard to picture and passage content; therefore, each test contained two dependent variables. In addition to the posttests, student attitude questionnaires were used to examine preferences in regard to the methods and topics.

2. Three treatments (methods) were compared in this study: booklets, stationary, and manipulative boards. Each treatment consisted of a set of 12 pictures and 12 passages, along with a question sheet.

3. Two lesson topics were used in this study: one on Wild Chimpanzees and one on Cave Indians. Both topics had identical specifications: i.e., the same size and number of pictures and passages. The question sheets also

had the same types and number of questions.

4. The primary statistic for this study was a multivariate analysis of variance (MANOVA). To determine which dependent variable(s) were significant, two ANOVA's were administered based on passage and picture content.

5. A total of 180 fifth grade students were randomly distributed among the method and topic combinations with each student randomly assigned to a single cell. Since the study was based on a 3 X 2 balanced design, there were 30 students assigned to each of six cells.

All 180 subjects were processed according to the same set of procedures. The design procedure used the following sequence:

1. The 180 subjects were randomly and evenly assigned in groups of six. At a given time, six subjects were working simultaneously and independently at each treatment. Depending on the size of the class, about five consecutive time blocks of 45 minutes each were needed to treat a class per day.

2. Each subject worked on a question sheet to accompany his/her particular topic and method (e.g., a Chimp stationary board). Each student was assigned to only one topic and method to maintain independence and to avoid multiple-treatment interference.

3. A posttest was administered to the entire class two days after the treatment. Half of the class was

tested on Wild Chimpanzees and the other half was tested on Cave Indians.

4. Student attitude questionnaires were used to survey the preferences and reactions of the students in regard to the methods and topics. A total of 80 students were given two treatments and two topics each. To avoid multiple-treatment interference, the researcher did not analyze the data from the second posttest scores.

Description of the Instruments

The instruments used to collect the data included achievement posttests and student attitude questionnaires. There were two posttests and three questionnaires.

1. Achievement Posttests. Two posttests (i.e., Chimps and Indians) were constructed to compare the instructional effectiveness of the three method treatments and the two instructional topics. Both tests conformed to the same structural specifications for establishing their parallel nature. For example, both tests contained 30 four-alternative items and 20 three-alternative items. Furthermore, both tests conformed to the same set of learning objectives. The first 30 items, based on passage content, tested two objectives: (1) recalling factual information and defining terminology; and (2) understanding conceptual relationships and generalizations. The last 20 items, based on picture content, tested two objectives:

(1) understanding conceptual relationships based on image recall; and (2) comparing objects within and/or between pictures based on image recall. The tests relied on a "cued recall" procedure for eliciting the student's retention of picture and passage content. The stem to each multiple-choice item referred back to information presented to the student during the treatment in either picture or passage form. (Table 3.1 compares the specifications for both tests and emphasizes their parallel nature.)

Both tests were designed for a course in test construction. After the tests were constructed, they were reviewed by the class instructor, Dr. Robert Ebel of Michigan State University, and revised by the author. Every effort was made to match the two tests in terms of reading level and vocabulary. The researcher used the "Fry Readability Graph" to assess the difficulty level of each posttest. The Fry method calls for the counting of syllables and sentences per 100 words. While multiple-choice items lend themselves to syllable counts, the sentences had to be extrapolated from the passages per 100 words. It was determined that the posttests were practically identical and, like the passage content, written between the fifth and sixth grade levels.

Two-way tables of specifications (see Tables 3.2 and 3.3) are provided for assessing the content validity and parallel nature of the two tests. The purpose of these

TABLE 3.1 Comparative Specifications for Two Achievement Tests

Form of Items	Chimp Test	Indian Test
Four-Alternative Items	30	30
Three-Alternative Items	20	20
Total Number of Items	50	50
Kinds of Objectives		
Factual Recall and Terminology (Based on Passage Content)	.24	.24
Conceptual Relationships/Generalizations (Based on Passage Content)	.36	.36
Conceptual Relationships (Based on Picture Content)	.20	.24
Comparing Visual Objects (Based on Picture Content)	.20	.16
Content Categories*		
Number of Categories	6	6
Item Range for Six Categories	4	4
Mean Number of Items Per Category	8.3	8.3

*Note: The six content categories for each test are not listed because they cover different topics and, therefore, provide a limited basis for comparison.

TABLE 3.2 Two-Way Table of Specifications for an Achievement Test on Wild Chimpanzees

TEST CONTENT CATEGORIES	LEARNING OBJECTIVES BASED ON QUESTIONS				
	Passage Content Categories		Picture Content Categories		
	1. Recalling Factual Information and Defining Terminology	2. Understanding Conceptual Relationships and Generalizations	1. Understanding Conceptual Relationships Based on Image Recall	2. Comparing Objects Within and/or Between Pictures Based on Image Recall	Percentage of Items for Each Content Category
1. Individual and Group Behavior of Grown Chimps	2	10	6		18
2. Parental Raising and Characteristics of Young Chimps	4	6	2		12
3. Physical Features and Characteristics of Grown Chimps	2	4	2	10	18
4. References to Scientists or Zoologists (Observations)	4	6	6		16
5. Comparisons and Interaction Between Chimps and Humans		4	4	8	16
6. Adapting to and Shaping the Habitat to Meet Basic Needs	12	6		2	20
Percentage of Items for Each Learning Objective	24	36	20	20	100

TABLE 3.3 Two-Way Table of Specifications for an Achievement Test on Cliff Village Indians

TEST CONTENT CATEGORIES	LEARNING OBJECTIVES BASED ON QUESTIONS: Passage Content Categories: 1. Recalling Factual Information and Defining Terminology	Passage Content Categories: 2. Understanding Conceptual Relationships and Generalizations	Picture Content Categories: 1. Understanding Conceptual Relationships Based on Image Recall	Picture Content Categories: 2. Comparing Objects Within and/or Between Pictures Based on Image Recall	Percentage of Items for Each Content Category
1. Roles and Responsibilities of Village Members for Fulfilling Basic Needs	4	8	6	2	20
2. References to Scientists or Archaeologists (Observations)	6	12		2	20
3. Basic Design and Construction of Villages (Dimensions/ Materials)	4	2	2	8	16
4. Cliff Village Kivas (Basic Construction and Living Purposes)	4	4	8		16
5. Natural and Man-Made Features Near the Village (Cliffs, Footholes, etc.)	4	4	2	4	14
6. Indian Handicrafts and Artifacts (Baskets, Pottery, etc.)	2	6	6		14
Percentage of Items for Each Learning Objective	24	36	24	16	100

tables is to define the scope and emphasis of the tests and to relate the objectives to the content. The tables add support to the content validity and parallel structure of the two tests by reflecting the percentage balance between corresponding categories. For example, the bottom row of figures in each table shows that both tests have very similar item percentages for each learning objective. These rows are particularly useful for comparing the balance between the two tests. (Note that the first two objectives total 60 percent because three-fifths of the items are concerned with passage content.)

The last column in each table lists the percentage of items for each content category. For the purpose of comparing the balance between the two tests, the last column in each table is not as meaningful as the bottom row in each table. This is due to the fact that the columns reflect different content (i.e., Chimps and Indians), whereas the rows are based on an identical set of objectives. The percentage of items within the matrix indicates a greater variation. For example, a few cells have a zero percent of items. Sometimes it is wise to leave a few empty cells since the pictures or passages may not provide worthy test items for those particular cells.

Stanley (1971) argues that the best guarantee of parallelism for two test forms is based on a complete and detailed set of specifications, which includes the dis-

tribution of items in regard to objectives and content areas. "If each test form is then built to conform to the outline, while at the same time care is taken to avoid identity or detailed overlapping of content, the two resulting test forms should be truly comparable" (p. 405).

As the tables indicate, each test was divided into two dependent variables: namely, picture and passage content. These variables were largely independent of each other: i.e., the passage questions could not be answered on the basis of picture retention and vice versa. This is not to say that these two variables were isolated from each other; obviously, the picture-passage pairings had an important role in reinforcing each other. There were three reasons for designing a test containing two dependent variables: (1) The researcher wanted to separate the picture and passage content in order to test the effectiveness of each one. There was a possibility that the two variables might not prove to be equally effective for each of the methods; (2) The researcher found that he could include and categorize most of the important concepts under picture or passage content; and (3) It would have been difficult to design a sufficient and unambiguous number of interdependent items which required a knowledge of both dependent variables. (See Appendix A for a copy of each posttest.)

2. Student Attitude Questionnaire. The achievement posttest provided performance data but no information

concerning the student's feelings toward the treatments. It was felt that questionnaires could provide some valuable insight into the posttest results by surveying student preferences. The researcher designed three brief questionnaires to find out how the students felt about the methods and topics. Form A compared the booklet to a stationary board; Form B compared the booklet to a manipulative board; and Form C compared the stationary board to a manipulative board.

The questionnaires were administered to three classrooms involving a total of 80 students. The questionnaires were administered after the posttests and before the posttest results were returned to avoid any interaction between scores and treatment preferences. One third of the students were given Form A because they had worked on a booklet and a stationary board (half of them started with the booklet and the other half started with the stationary board). Another third of the students were given Form B since they had worked on a booklet and a manipulative board. The final third of the students were given Form C because their treatments involved the stationary and manipulative boards.

Obviously, to administer the questionnaires, each student had to be given two treatments (two methods), two topics, and two posttests. To prevent multiple treatment interference, the researcher did not include the second

posttest scores in the statistical analyses (MANOVA and ANOVA models). While the second posttest was not subjected to the statistical models, the 80 students were given the second test to avoid student bias toward a certain method or topic. For example, if the students had been only tested for one method and topic, this may have biased their questionnaire responses to the second method and topic. (Appendix A includes an example of each questionnaire.)

Independent Variables

This study consisted of two independent variables: one based on methods of instruction and a second based on lesson topics. The methods of instruction were based on three formats: booklets, stationary, and manipulative boards. The lesson topics were based on Wild Chimps and Cave Indians. There was a booklet, stationary, and manipulative board for each topic; i.e., there was a set of three method formats for each topic.

1. Independent Variable: Methods. Each set of instructional methods contained an identical set of pictures and passages; i.e., they conformed to the same content and dimensions. For example, there was a booklet, stationary, and manipulative board with identical pictures and passages for each topic. The rationale for standardizing or equating the sets of pictures and passages across the method formats was based on the need to provide an unbiased comparison of the three methods. Since the most

important research hypothesis concerned the comparative effectiveness of the three methods, it was essential to control this independent variable by standardizing the pictures and passages for each topic across all three method formats.

At this point, it is appropriate to say a word about the potential for "weak experimental treatments." The researcher was aware that there was a real possibility that the results could be weakened by testing identical sets of pictures-passages for each topic and across each set of method treatments. However, it was considered a worthy risk for the sake of establishing a more valid and unbiased comparison of the method treatments. It was assumed that if the null hypotheses could not be rejected, then there would appear to be no particular advantage in using multiple-image boards as opposed to more conventional style booklets.

Each booklet, one on Wild Chimps and one on Cave Indians, contained a set of 12 pictures and 12 passages. The passages were placed immediately adjacent to the pictures to facilitate convenience and association. Each passage was between six and seven lines and contained an average of 90 words. If an important concept appeared in the passage, it was underlined and defined. (The pictures and passages are reproduced in Appendix C.)

The stationary and manipulative boards, like the

booklets, each contained a set of 12 pictures and 12 passages. The passages were located right beneath their corresponding pictures. There were two stationary and two manipulative boards to accommodate two topics. The lesson boards were designed to stand on table tops and had identical measurements. The pictures and passages were affixed to the surface of the stationary boards. The manipulative boards, in contrast, had picture and passage holders which allowed the student to locate and place the materials on the board surface. The student had to "manipulate" or arrange the materials in order to relate the pictures with the passages. (Figure 3.1 shows the lesson board design.)

The booklets, stationary and manipulative boards were specifically designed by the researcher for this study. While the booklets resembled a more traditional format than the boards, they did not constitute a control variable. The researcher began constructing and using display boards for use with his own students several years prior to the experiment.*

The stationary and manipulative boards were designed to present composite and stimulating displays which would fall well within the parameters of the visual field,

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*The manipulative board format led to an United States Patent No. 4115930 on September 20, 1978. The patent process called for an extended board surface for attaching and releasing a set of pictures and passages. The claims called for a single set or a plurality of subsets of informational material of a two or three dimensional nature.

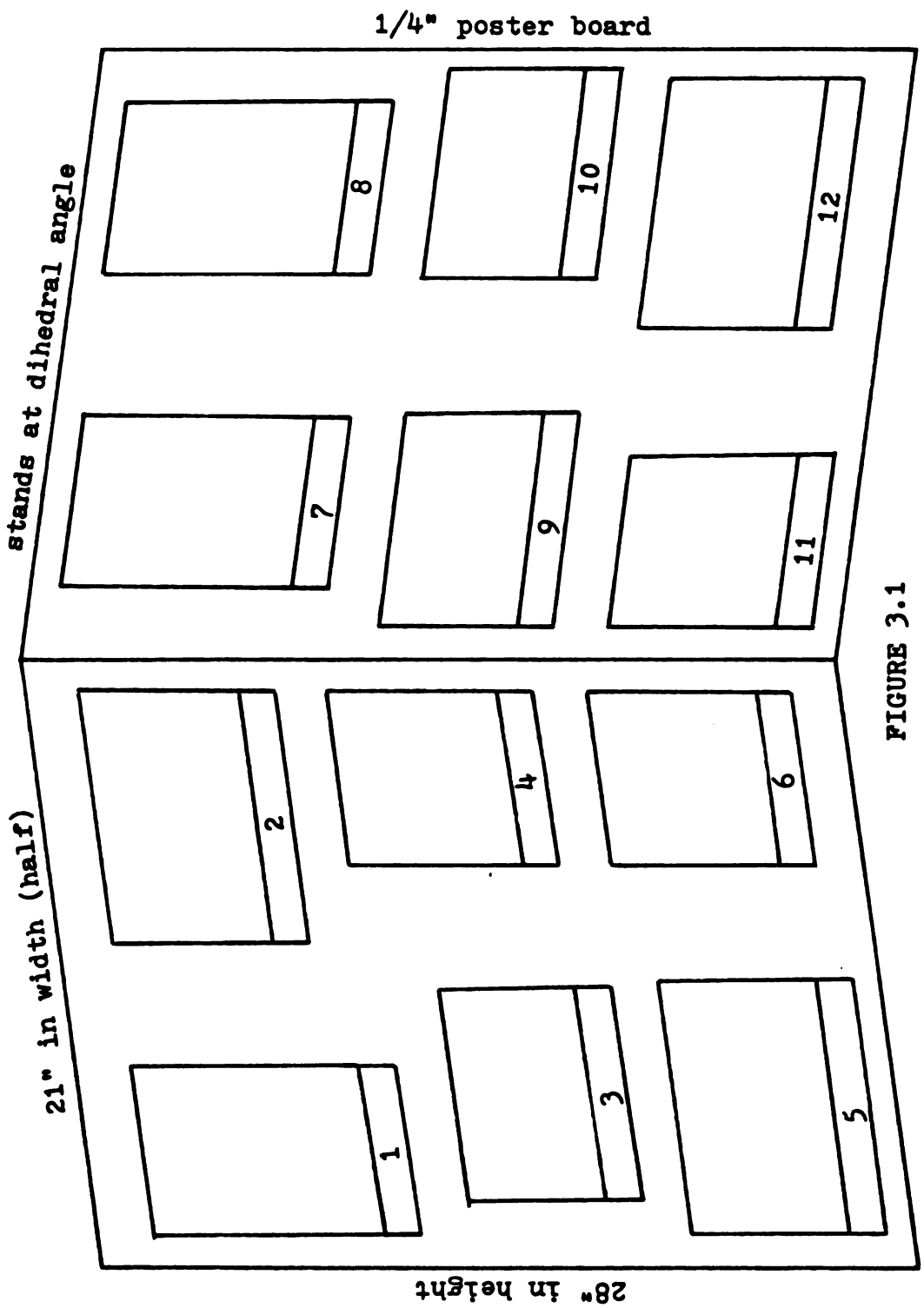


FIGURE 3.1

Lesson Board Design and Dimensions for Stationary and Manipulative Materials

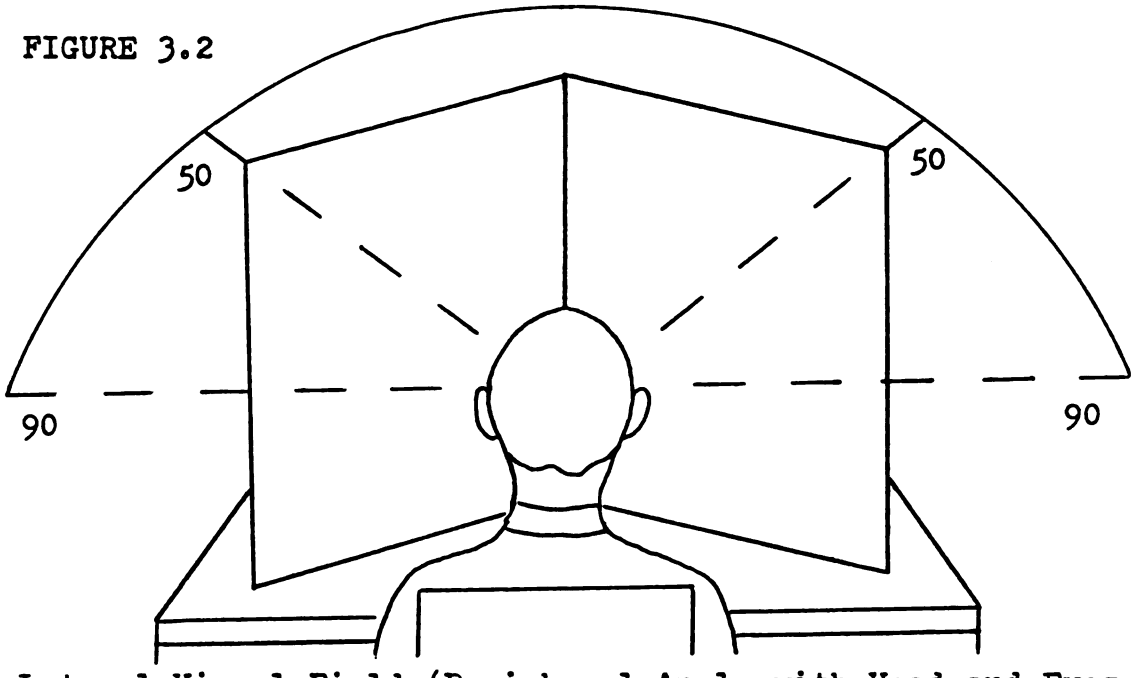
Pictures 1, 7, and 8 are 5 7/8" X 8." Pictures 3, 9, and 10 are 4 1/2" X 7 1/4."
Pictures 2, 5, and 12 are 5 3/8" X 9." Pictures 4, 6, and 11 are 5 3/4" X 5 3/4."

as defined by Gibson (1950). (Figures 3.2 and 3.3 illustrate the lateral and vertical dimensions of the visual field vis-a-vis the display boards.)

2. Independent Variable: Topics. The purpose in testing two topics, as opposed to one, was fourfold: (1) To determine whether a topic of higher interest would produce a higher degree of learning than a topic of lower interest for all three methods; (2) To determine whether an interaction might exist between a particular topic and method. For example, the higher or lower topic might be more effective with a particular method; (3) To provide more assurance that any demonstrated effects would not be attributable to the characteristics of a single topic. By testing two topics as opposed to one, there was a greater chance of detecting and confirming any significant differences between two method formats; and (4) To broaden the generalizability of the study to higher and lower interest topics.

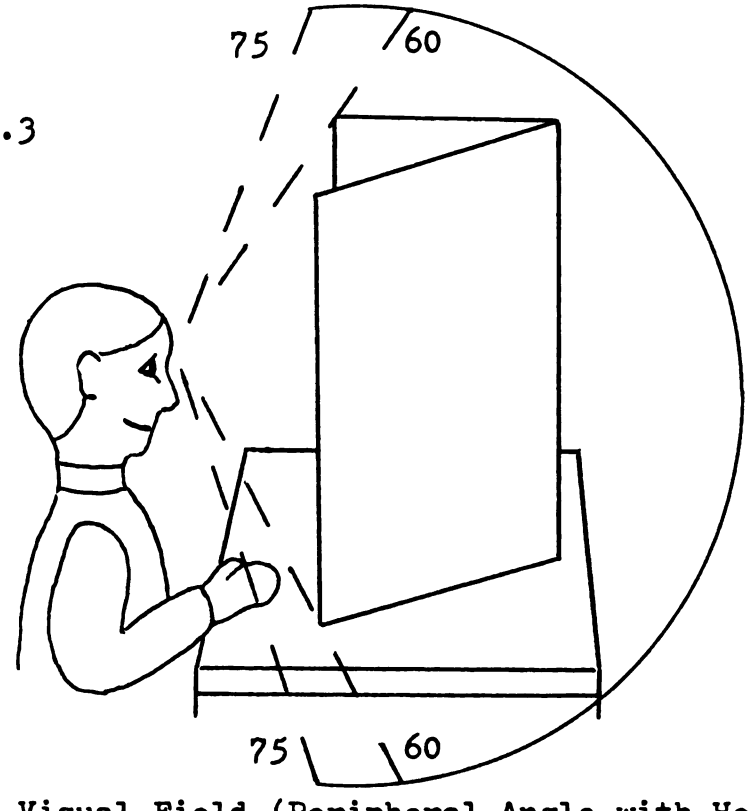
A "Fry Readability Graph" (Fry, 1977) was used to determine the reading level of each topic. A reading specialist determined that the passages were between a fifth and sixth grade level for both topics. The researcher decided to conduct the experiment with fifth grade students for two reasons: (1) The passages provided a smaller amount of reading material than the ordinary textbook assignment; and (2) The students would have sufficient time to read and reread the passages during the treatment time. They were

FIGURE 3.2



Lateral Visual Field (Peripheral Angle with Head and Eyes Held Stationary). Lateral Board Area (100 Degrees) Falls Within Lateral Visual Field (180 Degrees).

FIGURE 3.3



Vertical Visual Field (Peripheral Angle with Head and Eyes Held Stationary). Vertical Board Area (120 Degrees) Falls Within Vertical Visual Field (150 Degrees).

also encouraged to seek assistance with difficult words.

3. Question Sheets. There was a question sheet (lesson assignment) to accompany each of the three methods and two topics. The question sheet took about 45 minutes to complete depending on the speed and ability of the student. Each question sheet had a total of 16 questions divided into three parts: (A) Locating and Completing Passage Information; (B) Comparing Pictures and Choosing Titles; and (C) Creative Thinking Skills. Parts A and B were designed to sensitize the student to the passage and picture content. (The posttests also followed this passage and picture sequence.) Part C was based on open-ended responses (hypothetical problem solving and creative solutions) and the answers, for the most part, were not derived from the pictures or passages. None of the posttest items was derived from Part C; therefore, even though some of the students failed to complete this final part of the question sheet, they were not at a disadvantage when they took the posttest. Part C provided some flexibility in administering the treatment without biasing the instrument data. While all of the students were encouraged and given sufficient time to complete Parts A and B, the students were not required to finish Part C.

In the case of the booklet, the question sheet appeared at the end of the booklet. This procedure was designed to resemble the standard textbook procedure. In

regard to the stationary and manipulative boards, the question sheets were placed directly in front of the lesson boards. Regardless of whether the question sheet appeared in the back of a booklet or in front of a lesson board, each question sheet began by instructing the student to read the passages carefully before proceeding to answer the questions on paper. Since the location of the question sheet might have influenced the effectiveness of the treatments, this variable will be examined in the final chapter.

The booklets and stationary boards had an identical set of questions. The manipulative boards, unlike the booklets and stationary boards, began by asking the student to "Read each passage carefully and decide which picture goes above it" and then "place all 12 pictures above their passages." The student then checked an answer key to find out if the pictures were in their correct positions. Since all three methods instructed the students to begin by reading the passages carefully, the selection and placement of pictures on the manipulative board took about five additional minutes. To compensate for this additional procedure, the manipulative board question sheet had one less creative thinking question at the end of the assignment. Since these creative thinking questions were not included on the posttest, the deletion of one of these questions should not have been a disadvantage for the students who

were assigned to manipulative boards. (Appendix C has a complete set of treatment materials, including pictures, passages, and question sheets for both topics.)

Results of the Pilot Studies

The pilot studies served two major purposes: (1) They provided data for assessing the validity of the instruments; and (2) They subjected the treatments to a trial run for the purpose of identifying any special problems. The experimental materials were subjected to two pilot studies: 28 and 27 fifth grade students from two different classrooms in a Lansing elementary school.

1. Instrument Validation. The pretest data from the first pilot study revealed that the mean chance score for the Chimp passage content was 7.2 and 8.0 for the Indian passage content.* Since these scores were very close to the expected chance score of 7.5, this indicated that any prior knowledge of Wild Chimps or Cave Indians did not appear to influence the results. These chance scores also indicated that the test items were not too easy. However, the posttest mean scores, administered after the pilot study treatments, indicated that both tests were too difficult. For the posttest on Wild Chimps, the mean score

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*The pilot study pretest did not include the picture content because it would have been meaningless to ask students to recall and compare pictures which they had never seen. However, previous knowledge on Wild Chimps or Cave Indians could have influenced the passage results.

(passage and picture content combined) for 14 subjects was 53 percent. For the posttest on Cave Indians, 14 subjects had a mean score of 48 percent. After examining the test results the following changes were made: (1) Ten items of poor discrimination were deleted from each posttest; and (2) Several items were revised for purposes of clarification and precision. These changes resulted from an item analysis of each test and the observation that some students expressed dissatisfaction over the length of the posttest. (The original posttests had 60 multiple-choice items each and the revised tests had 50 items each.)

The data from the second pilot study is given in Figure 3.4. The expectations column gives projected data while the observations column cites actual data based on the second pilot study pretests (chance scores) and posttests (mean scores). The data from the second pilot study resulted in a Chimp mean score (passage and picture content combined) of 61 percent and an Indian mean score of 57 percent. These scores are quite close to the expected mean score of 64 percent. Since Figure 3.4 lists the passage and picture content separately, the scores must be combined to derive the total percentages.

In summary, the data in Figure 3.4 indicates that the expected and observed scores for the two achievement tests were quite similar. Since the tests were designed along parallel specifications, as outlined in Table 3.1,

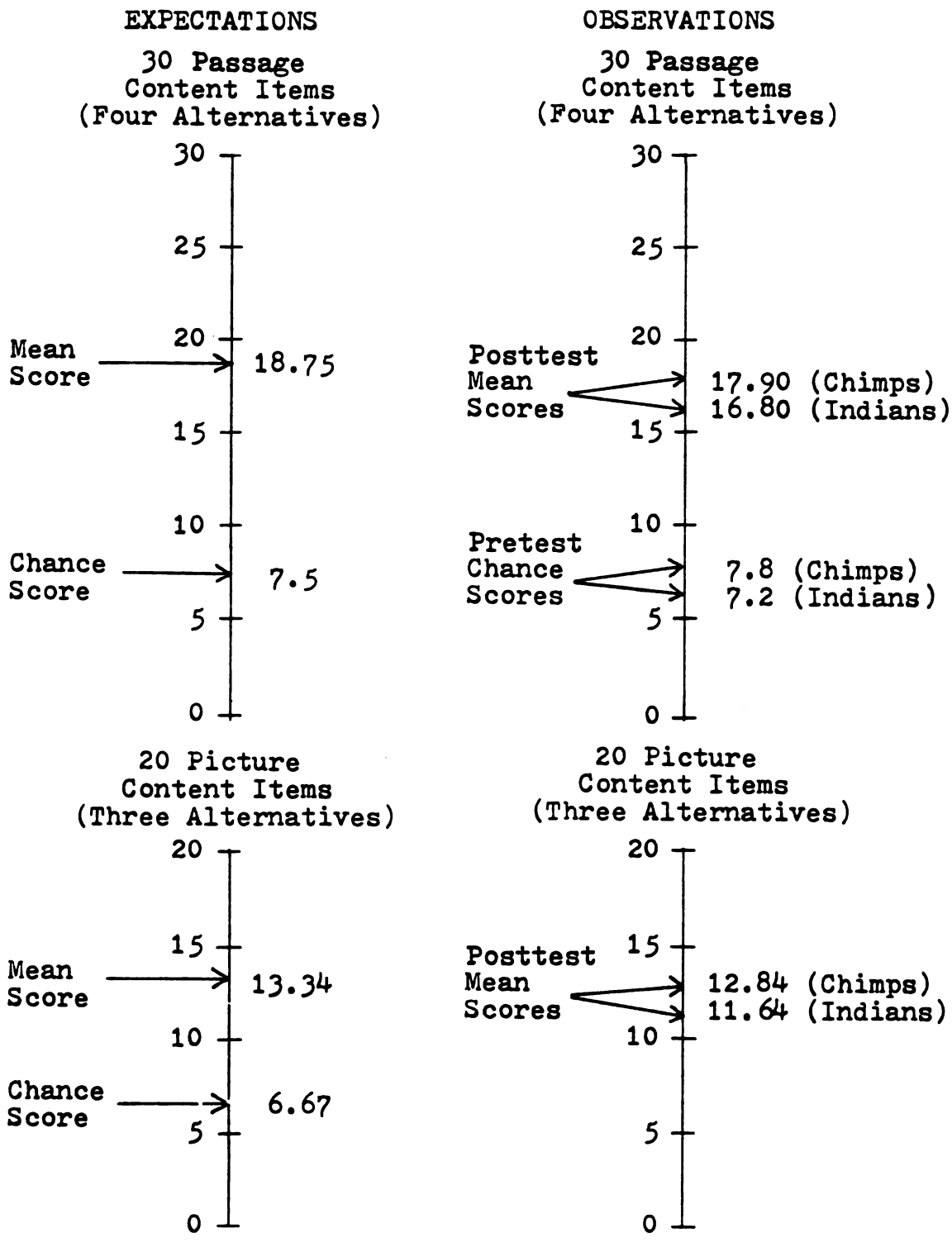

FIGURE 3.4

Expectations and Observations for Two Achievement Tests (Based on the Revised Tests of 50 Multiple-Choice Items)

the data in this figure adds support to the reliability of the instruments. However, it should be noted that the scores listed under the observation column were based on a small pilot study sample (14 tests on Wild Chimps and 13 tests on Cave Indians). In regard to the higher Chimp mean, this result will be discussed in the next chapter. Chapter four will also provide a detailed analysis of the instruments based on 80 subjects. A set of tables will provide a complete item-by-item analysis as well as Kuder-Richardson reliability coefficients.

2. Experimental Procedures. The following set of basic procedures was used to conduct the pilot study.*

The researcher held a brief orientation meeting for the fifth grade teachers about two weeks prior to the study. It was pointed out that the researcher would assume full responsibility for administering the treatments and correcting the assignment sheets and posttests. The teachers were very cooperative and agreed to refrain from discussing the methods and topics with the students until the experiment was completed. After introducing the materials and basic procedures, the following schedule was arranged: (1) On Friday, meet with the first class for a brief introductory meeting and pretest; (2) On the follow-

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*The same set of basic procedures was used to conduct the main experiment. However, unlike the pilot studies, the main experiment did not include a pretest. The rationale for this decision is discussed in the next part.

ing Tuesday, administer the treatments to groups of six subjects at a time; (3) On Thursday, two days after the treatment, administer a posttest; and (4) Repeat the same procedure for the next class.

First, the researcher conducted a brief introductory meeting with each class prior to the treatments. These meetings were designed to establish some rapport between the students and the researcher. The students were told that they would be working with a variety of materials and that they would be randomly assigned as they entered the room. In order to minimize student bias, they were told that it would not matter which materials they were assigned because the same topics were repeated in several formats. Furthermore, they were told that the researcher would introduce all of the materials after the lesson was completed. The researcher did not mention the topics or methods by name. In the case of the pilot studies, pretests based on the passage content were given at the end of this introductory meeting.

Second, on the day of the treatment, the students were sent to the experimental room in groups of six. As they entered the room, they were told to "Work carefully because you will be tested in two days to see how much you can remember about the pictures and passages. Raise your hand if you need help with certain words or directions." Each student then drew a number to determine the assigned

treatment: ones were assigned to booklets, twos were assigned to stationary boards, and threes were assigned to manipulative boards. Two color codings represented the topics: green for Chimps and brown for Indians. If the student had taken a pretest on Chimps, he/she was asked to select a brown card (Indians). There were several reasons for reversing the topics: (1) The primary purpose of the pretest had been to determine whether or not the scores would come close to the chance level; (2) The purpose was not to measure the gain score between the pre- and posttest; (3) This would minimize the possibility of an "interaction effect" between the test and treatment; and (4) It had already been decided that the actual experiment would be based on a posttest only design.

The treatments were placed at opposite ends of three long tables. The positions of the upright boards, standing at dihedral angles, made it difficult for the students to observe each others' treatments. For the purposes of conformity and privacy, an upright board with a blank surface, was placed in front of each booklet. Furthermore, the topics were alternated along the same table ends to prevent the same topic from being placed side-by-side. For example, if two Chimp boards had been placed at the same ends of two parallel tables, the student at the manipulative board might have received a picture placement cue from the stationary board. Since the boards

tended to shelter the topics and methods, plus the fact that the tables were situated about 15 feet apart, there was little opportunity for one treatment to interfere with or contaminate an adjacent treatment. Finally, the students were instructed not to visit or assist other students in the room.

Each student had a question (assignment) sheet with a set of simply worded directions. Since the treatments were basically self-contained and self-explanatory, there were a limited number of questions during the treatment period. The researcher helped when there was a question concerning the directions or the pronunciation of a word, but he did not provide any direct answers to the questions on the sheet. All the questions, in parts A and B, provided citations to particular passages and pictures, thus minimizing the need to ask questions. For the most part, the researcher sat some distance away from the tables. The researcher used a chart to tabulate the number of assistance requests and the average treatment time for for each method. After having processed 55 subjects, from two pilot studies, he found that the questions were almost evenly distributed among the treatments. There was an average of one question per subject. There was little variation in the amount of time required to complete each treatment. For example, the booklets required a mean time of 43 minutes while the boards required a mean time of 45

minutes. The researcher was flexible in terms of the time allotment and no effort was made to pressure the students. The atmosphere was quiet and relaxed and the students were exceedingly cooperative. As each student completed his treatment, he was asked to avoid discussing the treatment with other classmates until everyone had had a chance to complete the treatment. Since each class had between 27 and 28 students, it took five consecutive treatments to complete a class. The treatments began in the morning and ended about midway through the afternoon.

Third, two days after the treatments had been administered, the whole class was given a posttest. Naturally, if a student's treatment had been based on Indians, his posttest was based on the same topic. The students were given a simple set of directions and asked to work independently. They were told "to do the best you can and try to answer every question." They were instructed to "make your best guess rather than skip a question." The researcher chose not to apply a correction for guessing formula to the results. This decision was based on two considerations provided by Ebel (1979): (1) "Scores corrected for guessing will usually rank students in about the same relative positions as do uncorrected scores;" and (2) "Students' rational guesses can provide useful information on their general level of achievement" (pp. 194, 196).

Selection of a Posttest-Only Design

A posttest-only design was chosen over a pretest-posttest design after weighing the possible advantages and disadvantages of not administering a pretest. The decision was based on three arguments.

First, it was felt that a pretest based on the passage content could easily weaken the external validity of the study by risking an interaction between the pretest and the treatment. This appeared to be a likely occurrence since the test items were required to focus on passages which were condensed and restricted by their very definition. If the pretest items had been drawn from a larger body of information, there probably would have been less likelihood of an "interaction effect."

Second, it was felt that any pretest data gathered from the instruments would not prove very useful in controlling for "initial differences" for two reasons: (1) The pretest would have to be limited to passage content, as was the case in the pilot studies, which only constituted 60 percent of the posttest. It would have seemed rather meaningless to pretest the students on a set of pictures they had never seen before. However, they may have some knowledge of the passage content, albeit limited, based on some prior encounter with either topic. Nevertheless, a pretest based on 60 percent of the total test would have had serious limitations; and (2) The pilot study pretest indicated that most of the students scored very close to the chance

level. Therefore, the pretest data would have provided very little assistance in recognizing or controlling for initial differences. The very small variance on the pretest would also have made it difficult to match students.

Third, it was felt that initial differences could be controlled most effectively by two techniques: (1) By conducting a random assignment of subjects to the treatments as they entered the room; and (2) By selecting each group of six subjects on the basis of homogeneous reading levels.

The researcher felt that the second technique was particularly appropriate and effective. To begin with, each teacher composed a list of student groupings just before the experiment. Each group was based on a homogeneous reading level: such as all high readers, all average readers, and all low readers. These groupings were not discussed with the students. This homogeneous grouping added more precision to the random assignment process since it provided reasonable assurance that each treatment would receive a balance of students based on reading ability levels. Finally, it should be noted that after the ability groupings were formed, each group was randomly assigned to the treatments upon entering the room.

Finally, it may be argued that a posttest-only design was more appropriate for this study since a rather large sample (180 subjects) was involved. Borg and Gall

(1971) report that "...random assignment is most effective in equating groups when large numbers of subjects are involved" (p. 388).

Variables and Design Validity

Design validity will be discussed in terms of the guidelines established by Campbell and Stanley (1963).

1. Internal Validity. This study was designed to control for the following extraneous variables: (1) Maturation and experimental mortality were inconsequential since each class was processed within a span of two days, from treatment to posttest; (2) Testing and instrumentation were irrelevant considerations since this study excluded a pretest; (3) Statistical regression was also inapplicable since the subjects were not tested and retested; and (4) Differential selection was inoperable to this study since there was no control group.

There was some internal weakness in terms of the history variable. Since there was a time lapse between the treatment and the posttest, a socialization factor may have influenced the results. As previously noted, the subjects were asked not to discuss the treatments with other classmates until after the experiment.

In summary, it may be concluded that this experiment had strong internal validity with the exception of the history variable (i.e., the socialization factor).

2. External Validity. This study controlled for

the following extraneous variables: (1) The absence of a pretest eliminated any "reactive or interaction effect of testing;" and (2) The factor of "multiple treatment interference" was inoperable due to the fact that each subject was assigned to only one treatment.

There were two extraneous variables which limited the generalizability of the findings.

First, there was the interaction of the experimental treatment with particular student characteristics, measuring instruments, and the time of the study. For example, strictly speaking, the results of this study can only be generalized to fifth grade students who come from a school district which resembles the one in this study. Furthermore, the results were based strictly on a multiple-choice test and cannot be generalized to other measuring instruments.

Second, there was the "...possible artificiality of the experimental treatment and the students' knowledge that they are involved in an experiment" (Borg and Gall, 1971, p. 370). Since the students were aware that they were working with some novel materials, especially in the case of the display boards, this may have caused a change in their behavior. The novel situation may have caused a "Hawthorne effect." While the researcher can never adequately measure these effects, two observations based on the pilot studies are noteworthy: (1) Since the students

worked independently and did not receive special instructions or attention, this probably helped to offset the novelty of the situation; and (2) The students appeared very comfortable and relaxed while working with their treatments. This may have been due to two factors: (1) The introductory meeting probably helped to alleviate apprehensions and initial confusion; and (2) The upright boards partitioned the students and appeared to promote a sense of security.

Finally, two other considerations may have helped to offset the "Hawthorne effect:" (1) Identical topics were presented across all three methods; and (2) All three methods presented some degree of novelty since there was no control group.

3. Potential Confounding Variables. There were at least two additional factors, not included in the Campbell and Stanley Tables, which might have weakened the validity of this study. They included student and experimenter bias.

First, there was always the chance that student bias toward a treatment might have influenced behavior. Based on the pilot studies, three observations relate to this factor: (1) The researcher did not observe any verbal or visible opposition to the assignments; (2) The partitioning of treatments appeared to reduce subject awareness of different formats; and (3) The introductory meeting assured the students that they would have an opportunity,

after the treatments and posttests were completed, to view each topic and method.

Second, whenever a researcher conducts an experiment based on his own materials, there is a real danger of experimenter bias and contamination. As a matter of logistics, the researcher found it difficult to locate and train an assistant who would be able to devote the many hours and weeks required to gather the necessary data. In the case of the pilot studies, at least two conditions probably helped to alleviate experimenter contamination: (1) Because of the self-contained nature of the treatments, there was a minimal amount of subject/researcher interaction. When a question did arise, the researcher attempted to provide a brief encounter and clarification; and (2) The researcher was able to remain more neutral and detached by sitting some distance away from the treatments.

Statistical Models of Analyses

The primary statistical tool used in this study was a multivariate analysis of variance. A multivariate F-test was used to combine the passage and picture posttest scores. Univariate F-tests, based on analysis of variance models, were used to determine whether the passages and/or pictures were significant. Both the MANOVA and ANOVA models were tested at an alpha level of .05. Each statistical model included two Helmert planned comparisons for contrasting the methods.

Two-Way Multivariate Analysis of Variance

A two-way MANOVA was administered since the post-tests had been broken into two dependent variables: i.e., passage and picture scores. The two-way MANOVA provided a powerful tool for pooling and weighting the dependent variables to detect the level of significance. This was accomplished without dividing the alpha level. The two-way MANOVA was an appropriate tool since both dependent variables were based on the same underlying concept: namely, obtained knowledge.

Table 3.4 illustrates the layout of data for the 3 X 2 two-factor and two-way MANOVA. The independent variables (methods and topics) were regarded as fixed factors since they were drawn from target populations. It was a balanced design in the sense that each cell had an equal number of observations. The factors or main effects were crossed since every level of one of the factors appeared with every level of the other factor. The notation V_1 stood for the first dependent variable (passage content) and V_2 represented the second dependent variable (picture content). Each dependent variable had 30 observations.

It was assumed that the population sampled was normally distributed based on the Central Limit Theorem, which applies to sample of 30 subjects or more. It was believed that the homogeneity of variances of the comparison groups would remain approximately the same due to

Factor A (Main Effect) Independent Variable (Methods)	Factor B (Main Effect) Independent Variable (Topics)				
	B_1 Level Wild Chimpanzees		B_2 Level Cave Indians		
	V_1 Passages	V_2 Pictures	V_1 Passages	V_2 Pictures	
A_1 Level Lesson Booklets	n = 30		n = 30		60
A_2 Level Stationary Boards	n = 30		n = 30		60
A_3 Level Manipulative Boards	n = 30		n = 30		60
	90		90		180

Table 3.4

Layout of Data in a 3 X 2 Two-Factor MANOVA (Multivariate Analysis of Variance) Design with 30 Observations Per Cell

random assignment. The assumption of independence was met by assigning each subject to a single treatment (a combination of one method and one topic). Finally, the dependent measures provided continuous data and equal intervals on the posttest scale. It was concluded by the researcher that the assumptions for the MANOVA had been fulfilled. It should be noted that these assumptions also applied to the two-way ANOVA.

Two-Way Analysis of Variance

Since the MANOVA results led to the rejection of two null hypotheses, univariate F-tests, using two-way ANOVA models, were conducted to determine whether the passage and/or picture scores were significant. Since the two-way ANOVA was designed to test a single dependent variable, two ANOVA models were applied to this study: one for the passage variable and one for the picture variable.

The two-way MANOVA and ANOVA models included two Helmert planned comparisons based on the first two hypotheses. The first planned comparison tested the booklet group versus the stationary and manipulative board groups. The second planned comparison tested the stationary board group versus the manipulative board group.

Statistical Hypotheses

This study was based on three statistical hypotheses. For the purpose of testing, they were stated in the null form.

1. There would be no difference in the means of the booklet group versus the stationary and manipulative board groups in regard to the dependent variables: passage and picture content.

2. There would be no difference in the means of the stationary board group versus the manipulative board group in regard to the dependent variables: passage and picture content.

3. There would be no difference in the means of

the two topic groups (Chimps versus Indians) in regard to the dependent variables: passage and picture content.

Summary

A sample of 180 fifth grade students were randomly assigned to six balanced groups: three methods (booklets, stationary, and manipulative boards) and two topics (Chimpanzees and Indians). Each student was assigned to a single method and topic. The question sheets for each method and topic paralleled each other in regard to the number and type of questions.

Achievement posttests were the primary instruments used in this study. Each posttest had 50 multiple-choice items divided into 30 passage content items and 20 picture content items. Both tests conformed to the same structural specifications for establishing their parallel nature. For example, both tests had the same set of learning objectives and reading levels.

Two pilot studies were conducted to test the validity of the instruments and treatment procedures. Some of the more difficult items were revised after the first pilot study. The second pilot study indicated that the expected and observed scores for the two achievement tests were quite similar.

Based on the guidelines established by Campbell and Stanley (1963), this study had strong internal validity with the exception of the history variable (i.e., the

socialization factor). Two extraneous variables posed threats to the external validity. First, there was the interaction of the experimental treatment with particular student characteristics, measuring instruments, and time of the study. Second, there was the possibility that the students' awareness of the experimental treatment might produce a contrived response.

The major statistical model was a two-way MANOVA. The dependent variables (passage and picture posttest scores) were combined as a multivariate. Univariate F-tests, using two-way ANOVA models, were conducted to determine whether the passage and/or picture scores were significant. The two-way MANOVA and ANOVA models included two Helmert planned comparisons based on the methods. Each statistical model was tested at an alpha level of .05.

CHAPTER IV

ANALYSIS OF THE DATA

This chapter includes the following topics: Purposes of the Study; Research and Test Hypotheses; and Findings of the Study. These findings are used to test the null hypotheses. An interpretation of these findings and conclusions will be presented in Chapter V.

Purposes of the Study

This study had three purposes. First, the study attempted to find out whether a simultaneous presentation of pictures and passages, as exemplified by the stationary and manipulative boards, would be more conducive to learning than a successive presentation of pictures and passages, as exemplified by the booklets. Second, the study attempted to find out whether the manipulative boards, which required the students to position the pictures above their appropriate passages, would be more conducive to learning than the stationary boards, which presented the pictures already mounted above their appropriate passages. Third, the study attempted to find out whether a topic of higher student interest would be more conducive to learning than a topic of lower student in-

terest for each of the treatments: booklets, stationary, and manipulative boards.

Research and Test Hypotheses

Three research hypotheses were derived from the purposes of the study and a review of the relevant literature. The first two hypotheses were based on the methods and the third hypothesis was based on the topics.

First, the mean scores associated with the stationary board group and the manipulative board group were each expected to exceed the mean score associated with the booklet group. This expectation applied to both dependent variables: passage and picture content.

Second, the mean score associated with the manipulative board group was expected to exceed the one associated with the stationary board group. This expectation applied to both dependent variables: passage and picture content.

Third, the mean score associated with the topic of higher interest (Chimps) was expected to exceed the one associated with the topic of lower interest (Indians) for each of the methods. This expectation applied to both dependent variables: passage and picture content.

Three test hypotheses were used with the multivariate analysis of variance. The hypotheses were expressed in the null and alternate forms.

The first null hypothesis stated that there would

be no difference in the mean of the booklet group (T1) to those of the stationary board group (T2) and the manipulative board group (T3).

$$H_o1 = \mu_{T1} = \frac{\mu_{T2} + \mu_{T3}}{2}$$

The first alternate hypothesis stated that the means of the stationary board group (T2) and the manipulative board group (T3) would exceed that of the booklet group (T1).

$$H_a1 = \mu_{T1} < \frac{\mu_{T2} + \mu_{T3}}{2}$$

The second null hypothesis stated that there would be no difference in the means of the stationary board group (T2) and the manipulative board group (T3).

$$H_o2 = \mu_{T2} = \mu_{T3}$$

The second alternate hypothesis stated that the mean of the manipulative board group (T3) would exceed that of the stationary board group (T2).

$$H_a2 = \mu_{T2} < \mu_{T3}$$

The third null hypothesis stated that there would be no difference in the means of the higher-interest topic (Chimps) group and the lower-interest topic (Indians) group.

$H_o3 = \mu_{I1} = \mu_{I2}$ (Note: I1 = Chimps, I2 = Indians)

The third alternate hypothesis stated that the mean of the higher-interest topic (Chimps) group would exceed

that of the lower-interest topic (Indians) group.

$H_a3 = \mu_{I1} > \mu_{I2}$

For the multivariate test of significance, the alpha level was set at .05. To reject a null hypothesis, the test required a significant difference for at least one of the dependent variables: passage and/or picture content.

Findings of the Study

The findings for this study were based on a convenient sample of 180 fifth grade students. In the case of the two-way MANOVA and two-way ANOVA's, the subjects were randomly assigned to six balanced groups: 30 subjects each.

Two-Way Multivariate Analysis of Variance

A two-way MANOVA was performed on the posttest data from 180 subjects. The dependent variables (passage and picture posttest scores) were combined as a multivariate. The two independent variables included three methods (booklets, stationary, and manipulative boards) and two topics (Chimps and Indians).

Table 4.1 reveals that the null hypothesis for interaction was not rejected. Factor A (Methods) was broken down into two planned comparisons. The null hypothesis (H_o1) for methods was rejected since there was a significant difference between the booklets versus the stationary and manipulative boards. According to the significance of

Table 4.1 Two-Way MANOVA (Fixed Effects) Based on Multivariate F-Tests (Passage and Picture Content Combined)

Source of Variation	df	Standardized Discriminant Function Coefficients: Passage	Standardized Discriminant Function Coefficients: Picture	Approx. F	Sig. F
Factor A (Methods) Two Planned Comparisons					
Booklets vs. Stationary and Manipulative Boards	2	-.683	1.153	7.57	.001
Stationary vs. Manipulative Boards	2	1.121	-.312	1.582	.209
Factor B (Topics) Chimpanzees and Indians	2	.824	.287	5.855	.003
Interaction (A X B) Methods by Topics	4	.830	.279	.288	.886
Within	348				
	358				

Note: The degrees of freedom under Factor A (Methods) were partitioned into two Helmert Planned Comparisons. Alpha remained at .05 for each comparison.

the F value, the alternate hypothesis (H_a1) for methods was significant at .001. The null hypothesis (H_o2) for methods (stationary vs. manipulative boards) was not rejected. The null hypothesis (H_o3) for topics was rejected. The alternate hypothesis (H_a3) for topics was significant at the .003 level.

Two-Way Analysis of Variance

Since the MANOVA results led to the acceptance of two alternate hypotheses (H_a1 and H_a3), univariate F-tests were conducted to determine whether the passage and/or picture scores were significant. Tables 4.2 and 4.3 examine the significance between groups on the passage and picture content scores. Both two-way ANOVA's include two Helmert planned comparisons based on the methods hypotheses.

Table 4.2 reveals that there was a significant difference between the topics in terms of the passage scores at a significance level of .001. The univariate planned comparisons indicate that the methods had a nonsignificant effect in terms of passage content. However, it is worth noting that if the alpha level had been set at .10, there would have been a significant difference between the boards.

Table 4.3 reveals that there was also a significant difference between the topic groups in terms of the picture scores. The first planned comparison indicates that there was a significant difference between the booklet group vs. the stationary and manipulative board groups.

Table 4.2 Two-Way ANOVA (Fixed Effects) Based on Univariate F-Tests for Passage Content

Source of Variation	df	SS	MS	Approx. F	Sig. F
Factor A (Methods) Two Planned Comparisons					
Booklets vs. Stationary and Manipulative Boards	1	5.878	5.875	.155	.695
Stationary vs. Manipulative Boards	1	112.133	112.133	2.950	.088
Factor B (Topics) Chimpanzees vs. Indians	1	420.139	420.139	11.053	.001
Interaction (A X B) Methods by Topics	2	30.344	15.172	.399	.671
Within	174	6613.7	38.01		
	179	7182.194	40.124		

Note: The degrees of freedom under Factor A (Methods) were partitioned into two Helmert Planned Comparisons. Alpha remained at .05 for each comparison.

Table 4.3 Two-Way ANOVA (Fixed Effects) Based on Univariate F-Tests for Picture Content

Source of Variation	df	SS	MS	Approx. F	Sig. F
Factor A (Methods) Two Planned Comparisons					
Booklets vs. Stationary and Manipulative Boards	1	91.003	91.003	9.936	.002
Stationary vs. Manipulative Boards	1	1.875	1.875	.205	.652
Factor B (Topics) Chimpanzees vs. Indians	1	53.356	53.356	5.826	.017
Interaction (A X B) Methods by Topics	2	5.278	2.639	.288	.75
Within	174	1593.6	9.159		
	179	1745.112	9.749		

Note: The degrees of freedom under Factor A (Methods) were partitioned into two Helmert Planned Comparisons. Alpha remained at .05 for each comparison.

Tables 4.4 and 4.5 reveal which methods and topics had the highest mean scores for passages and pictures. (Note that the mean scores were lower in Table 4.5 since there were 20 picture items compared to 30 passage items in Table 4.4) A comparison of the two tables indicates that the subjects did better on the passage items than on the picture items. For example, the expected mean score for 30 passage items was 18.75. A look at the column means in Table 4.4 shows that the Chimps scored (20.22) above the expected mean while the Indians scored (17.17) below the expected mean. The expected mean score for 20 picture items was 13.34. A look at the column means in Table 4.5 shows that the Chimps (11.77) and Indians (10.68) scored below the expected mean.

The row and column means provide some essential data for interpreting the MANOVA and ANOVA results. If we compare the row means in Table 4.5, we learn that the subjects scored higher on the boards than on the booklets in terms of picture content. The column means in both tables show that the Chimps outscored the Indians in both passage and picture content. A discussion of these results and some conclusions are presented in Chapter V.

Figures 4.1 and 4.2 provide a graphic representation of the passage scores recorded in Table 4.4. Figure 4.1 shows that the stationary and manipulative boards were nearly parallel across the topics, thus minimizing the in-

Table 4.4 Cell, Row, and Column Means and Standard Deviations for 30 Passage Items Based on 30 Observations Per Cell

	Wild Chimpanzees	Cave Indians	Row Mean S.D.
Booklets	Mean = 19.9 S.D. = 7.227	Mean = 18.0 S.D. = 5.395	18.95 6.311
Stationary Boards	Mean = 21.4 S.D. = 6.5	Mean = 17.667 S.D. = 5.274	19.534 5.887
Manipulative Boards	Mean = 19.367 S.D. = 6.856	Mean = 15.833 S.D. = 5.446	17.6 6.151
Column Mean S.D.	20.222 6.861	17.167 5.372	

Table 4.5 Cell, Row, and Column Means and Standard Deviations for 20 Picture Items Based on 30 Observations Per Cell

	Wild Chimpanzees	Cave Indians	Row Mean S.D.
Booklets	Mean = 10.567 S.D. = 3.36	Mean = 9.867 S.D. = 3.037	10.217 3.199
Stationary Boards	Mean = 12.367 S.D. = 2.735	Mean = 11.333 S.D. = 3.304	11.85 3.02
Manipulative Boards	Mean = 12.367 S.D. = 2.846	Mean = 10.833 S.D. = 2.817	11.6 2.832
Column Mean S.D.	11.767 2.980	10.678 3.053	

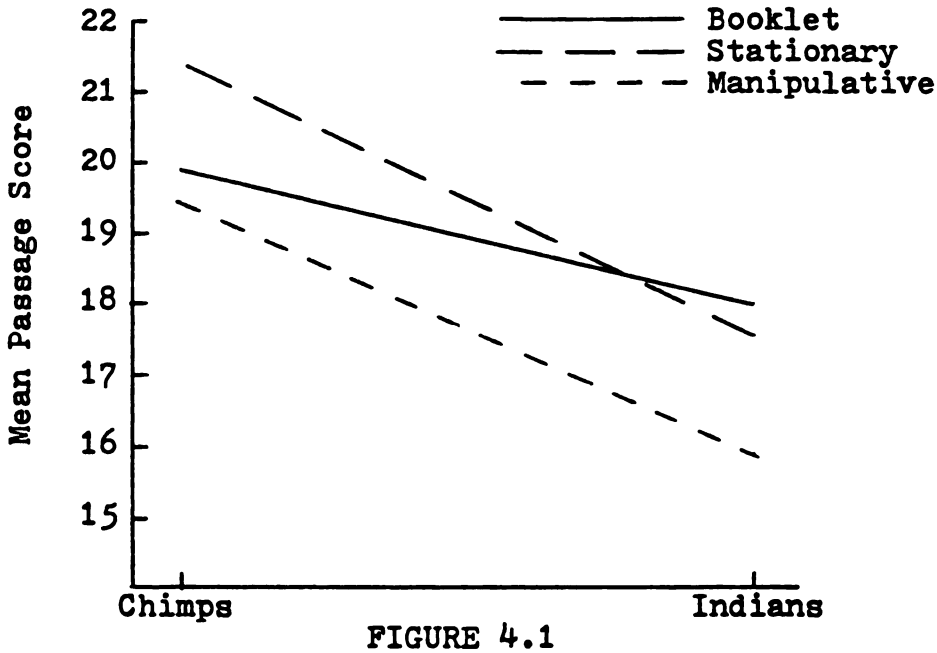


FIGURE 4.1

Graphic Representation of the Mean Passage Scores for Three Methods of Presentation on Two Topics

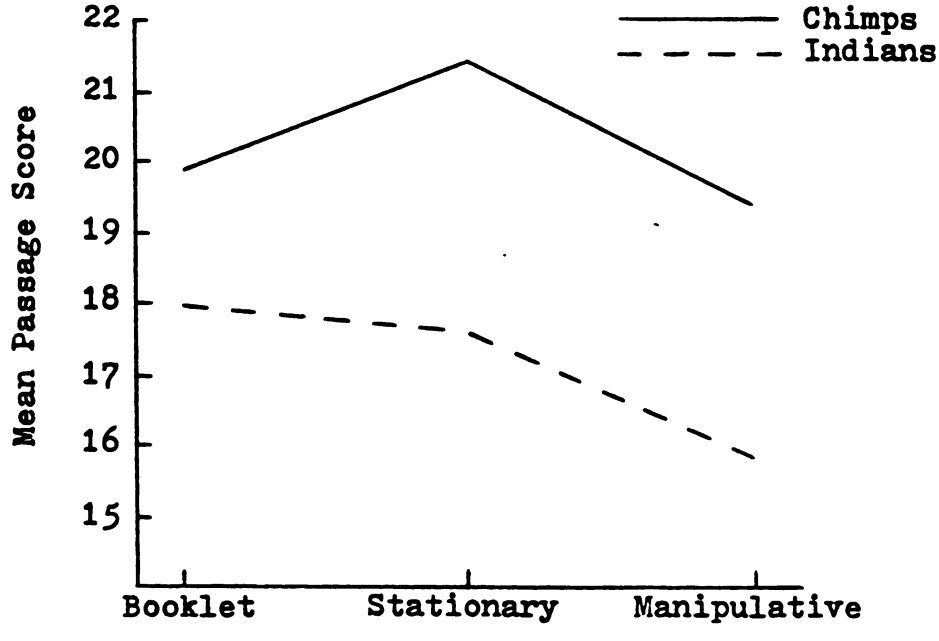


FIGURE 4.2

Graphic Representation of the Mean Passage Scores for Two Topics on Three Methods of Presentation

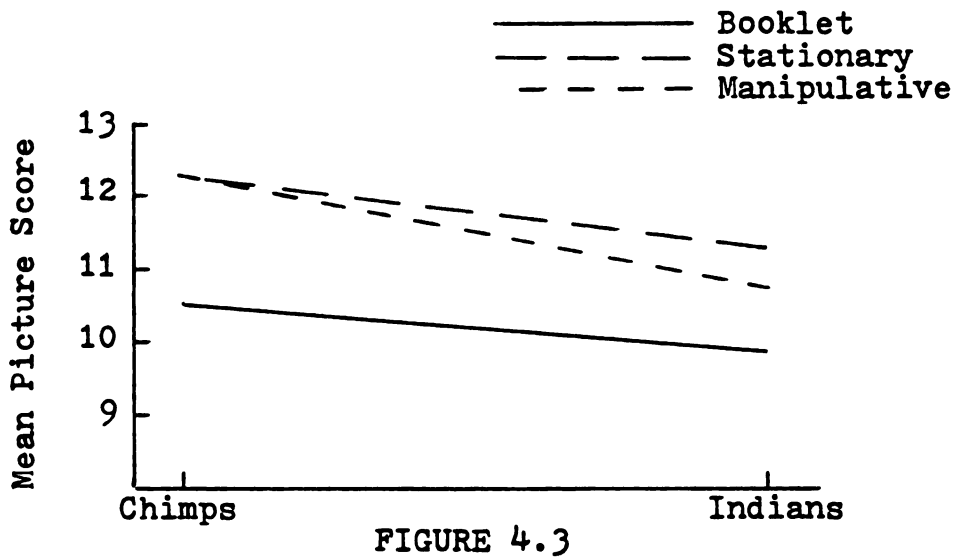


FIGURE 4.3

Graphic Representation of the Mean Picture Scores for Three Methods of Presentation on Two Topics

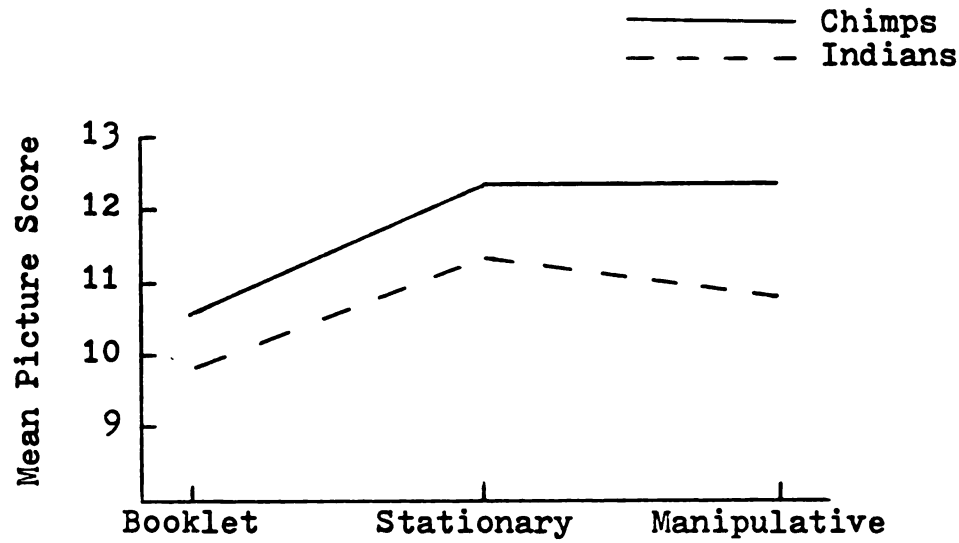


FIGURE 4.4

Graphic Representation of the Mean Picture Scores for Two Topics on Three Methods of Presentation

teraction between these two methods and the topics. Figure 4.1 depicts some disordinal interaction (a crossing between the booklets and the stationary boards). Figure 4.2 shows that the mean passage scores for the Chimps were consistently and significantly higher than those for the Indians across all three methods. It also shows that the mean scores for the Chimps peaked on the stationary boards.

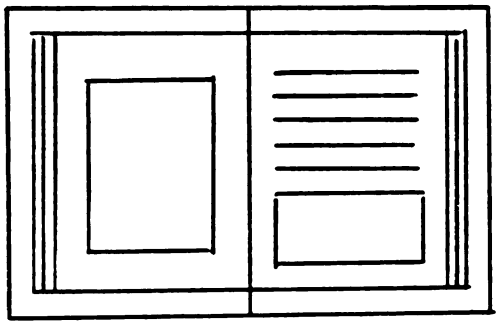
Figures 4.3 and 4.4 provide a graphic representation of the mean picture scores recorded in Table 4.5. Figure 4.3 shows that the stationary boards and the booklets were nearly parallel across the topics, thus minimizing the interaction between these two methods and the topics. It also shows that the mean scores for the stationary and manipulative boards were very similar and significantly higher than those for the booklets across both topics. Figure 4.4 shows that the mean picture scores for the Chimps were consistently and significantly higher than those for the Indians across all three methods.

In summary, the four figures indicate why the null hypothesis ($H_0 3$) for interaction could not be rejected. While all four figures showed some ordinal interaction (nonparallel lines tending to merge), it was not significant.

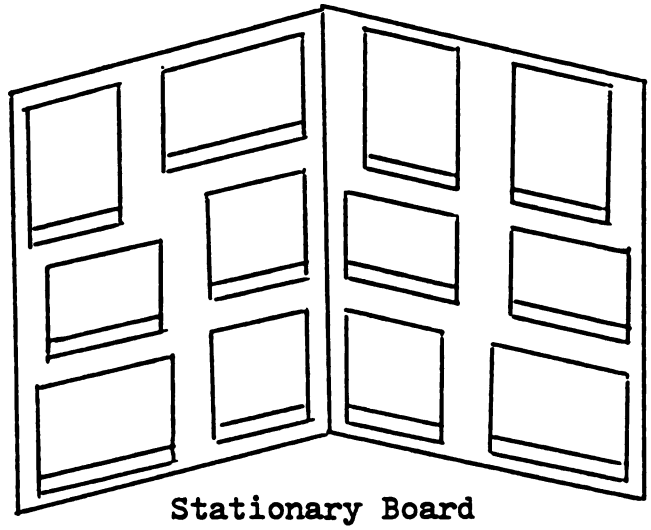
Student Questionnaire Data

Tables 4.6, 4.7, and 4.8 present the response data for the student attitude questionnaires. A total of 80

Table 4.6 Responses of 27 Students to an Attitude Questionnaire (Form A: Comparing a Booklet to a Stationary Board)



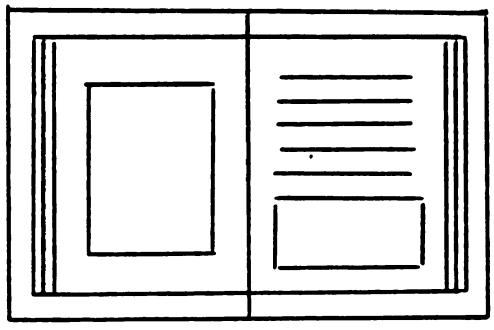
Lesson Booklet



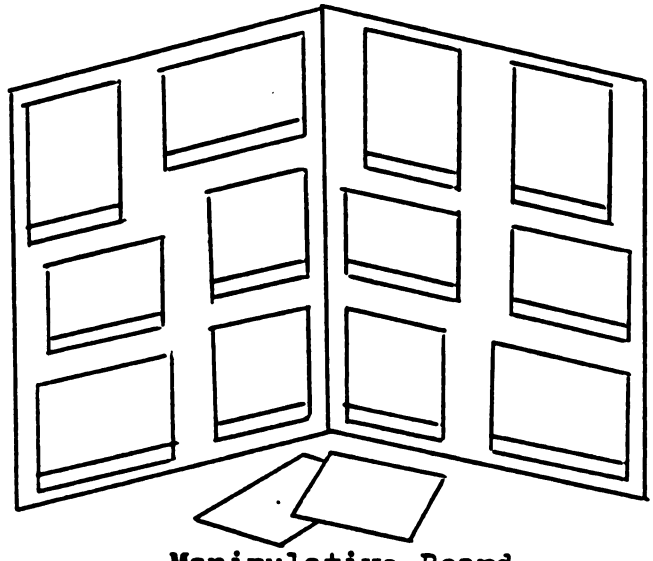
Stationary Board

	Question Options	Student Responses
1.	(a) Preferred the booklet the most	9
	(b) Preferred the stationary board the most	16
	(c) Did not prefer one style more than the other	2
2.	(a) Preferred to see the pictures page-by-page	10
	(b) Preferred to see all the pictures at one time	15
	(c) Did not prefer one layout over the other	2
3.	(a) Found the booklet directions easier	9
	(b) Found the stationary board directions easier	9
	(c) Did not find one set of directions any easier	9
4.	(a) Enjoyed the Wild Chimpanzees the most	15
	(b) Enjoyed the Cave Indians the most	9
	(c) Did not enjoy one topic more than the other	3

Table 4.7 Responses of 26 Students to an Attitude Questionnaire (Form B: Comparing a Booklet to a Manipulative Board)



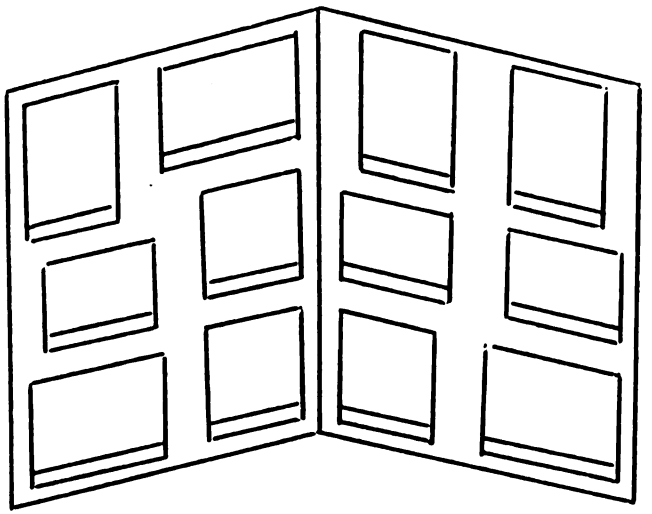
Lesson Booklet

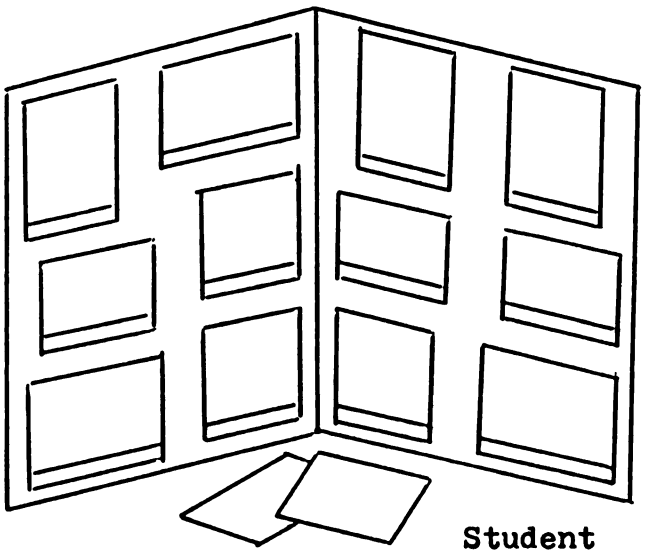


Manipulative Board

	Question Options	Student Responses
1.	(a) Preferred the booklet the most	8
	(b) Preferred the manipulative board the most	18
	(c) Did not prefer one style more than the other	0
2.	(a) Preferred to see the pictures page-by-page	10
	(b) Preferred to see all the pictures at one time	16
	(c) Did not prefer one layout over the other	0
3.	(a) Found the booklet directions easier	8
	(b) Found the manipulative board directions easier	10
	(c) Did not find one set of directions any easier	8
4.	(a) Enjoyed the Wild Chimpanzees the most	16
	(b) Enjoyed the Cave Indians the most	8
	(c) Did not enjoy one topic more than the other	2

Table 4.8 Responses of 27 Students to an Attitude Questionnaire (Form C: Comparing a Stationary to a Manipulative Board)





Question Options	Student Responses
1. (a) Preferred the board with the pictures already on it	6
(b) Preferred to place the pictures on the board	17
(c) Did not prefer one board more than the other	4
2. (a) Found the stationary board directions easier	10
(b) Found the manipulative board directions easier	11
(c) Did not find one set of directions any easier	6
3. (a) Enjoyed the Wild Chimpanzees the most	17
(b) Enjoyed the Cave Indians the most	6
(c) Did not enjoy one topic more than the other	4

students were each given two treatments (two methods) and both topics. In order to avoid multiple-treatment interference, the data from the second treatment was excluded from the MANOVA and ANOVA models.

If we combine the student's responses for question one in Tables 4.6 and 4.7, we find that the respondents preferred the stationary and manipulative boards to the booklets by 64% to 32%. (For example, the booklets received a total of 17 responses to 34 for the boards.) The remaining 4% of the respondents expressed no preference for either the booklets or boards. If we combine the student's responses for question two, we find that the respondents preferred to see a simultaneous picture format (i.e., the boards) to a successive picture format (i.e., the booklets) by 58% to 38%. The remaining 4% of the respondents expressed no preference for a particular picture presentation. There were 53 responses to each question.

The data from question one in Table 4.8 shows that the respondents preferred the manipulative over the stationary set of pictures by 63% to 22%. The remaining 15% of the respondents expressed no preference for either board format. There were a total of 27 responses.

If we combine the students' responses for question three in Tables 4.6 and 4.7, we find the respondents were more evenly divided on the question of which method provided the easiest directions to follow. The combined data

shows that 36% chose the boards, 32% the booklets, and 32% did not find one set of directions any easier than the other. There were 53 responses to each question.

The data from question two in Table 4.8 shows that the respondents found the manipulative boards easier to understand than the stationary boards by 41% to 37%. The remaining 22% did not find one board format any easier to understand than the other. There were 27 responses.

The final question on all three questionnaires asked the students if they preferred one topic more than the other. If we combine the student's responses for all three tables, we find that 60% preferred the Chimps, 29% chose the Indians, and 11% did not prefer one topic more than the other. Since all 80 students responded to the last question, the results would tend to be more reliable than the preceeding questions.

The students were given the option of stating a reason, on the back of the questionnaires, for preferring one topic over the other. For those respondents who chose the Chimps, the three most common reasons were as follows: (1) Chimps are interesting and intelligent; (2) The Chimp pictures were very interesting; and (3) It would be fun to live with Chimps and teach them tricks.

While only half as many respondents preferred the Indians, the two most common reasons were as follows: (1) It would be fun to explore a village cave; and (2) We

should learn about Indians because they were the first Americans.

Posttest-Questionnaire Data Analysis

The data from the posttest scores and the student attitude questionnaires was analyzed to determine whether any relationship might be detected. For example, did respondents with high posttest scores tend to prefer a certain method and topic? Since the posttests and questionnaires relied on different forms of data (continuous scores as opposed to attitude categories) the researcher could not apply an established correlation procedure to the instruments. Furthermore, this posttest-questionnaire analysis was limited to the 80 subjects who took two methods (treatments) and both topics.

To conduct this analysis, the researcher began by recording the subjects' posttest scores on their questionnaires. The questionnaires were then divided into three piles: one based on high posttest scores; a second based on average posttest scores; and a third pile based on low posttest scores. Each group was tallied in terms of method and topic preferences. (The percentage results are given in Tables 4.9, 4.10, 4.11, and 4.12.)

In Table 4.9, it should be noted that respondents who received average or low posttest scores preferred the stationary boards to the booklets by a three-to-one margin. Respondents with high posttest scores indicated a

Table 4.9 Relationship Between Posttest Scores and Method Preferences (Booklets Versus Stationary Boards) Based on 27 Respondents

Posttest Levels	Methods			Total Percentage
	Prefer Booklets	Prefer Stationary Boards	No Method Preference	
High Posttest Scores (Upper Third)	56%	44%	0%	100%
Average Posttest Scores (Middle Third)	22%	67%	11%	100%
Low Posttest Scores (Lower Third)	22%	67%	11%	100%

Table 4.10 Relationship Between Posttest Scores and Method Preferences (Booklets Versus Manipulative Boards) Based on 26 Respondents

Posttest Levels	Methods			Total Percentage
	Prefer Booklets	Prefer Manipulative Boards	No Method Preference	
High Posttest Scores (Upper Third)	22%	78%	0%	100%
Average Posttest Scores (Middle Third)	44%	56%	0%	100%
Low Posttest Scores (Lower Third)	25%	75%	0%	100%

Table 4.11 Relationship Between Posttest Scores and Method Preferences (Stationary Versus Manipulative Boards) Based on 27 Respondents

Posttest Levels	Methods			Total Percentage
	Prefer Stationary Boards	Prefer Manipulative Boards	No Method Preference	
High Posttest Scores (Upper Third)	33%	67%	0%	100%
Average Posttest Scores (Middle Third)	11%	78%	11%	100%
Low Posttest Scores (Lower Third)	22%	45%	33%	100%

Table 4.12 Relationship Between Posttest Scores and Topic Preferences (Chimps Versus Indians) Based on 80 Respondents

Posttest Levels	Topics			Total Percentage
	Prefer Chimps	Prefer Indians	No Topic Preference	
High Posttest Scores (Upper Third)	70%	15%	15%	100%
Average Posttest Scores (Middle Third)	67%	30%	3%	100%
Low Posttest Scores (Lower Third)	42%	46%	12%	100%

slight preference for the booklets.

In Table 4.10, respondents who received high or low posttest scores preferred the manipulative boards to the booklets by more than a three-to-one margin. Respondents with average posttest scores indicated a small preference for the manipulative boards. If we combine the data from Tables 4.9 and 4.10, we find that low posttest respondents consistently endorsed the boards over the booklets by a three-to-one margin.

Table 4.11 shows that the respondents at all three posttest levels decisively preferred the manipulative boards to the stationary boards. While respondents in the high and low posttest levels preferred the manipulative boards by a two-to-one margin, average posttest respondents chose the manipulative boards by a seven-to-one margin.

It should be noted that Tables 4.9, 4.10, and 4.11 were based on samples of 27, 26, and 27 respondents. Each one of these samples was divided into three posttest levels. It should be noted that smaller samples tend to be less reliable than larger samples.

Table 4.12 was based on 80 respondents or a combined total of the three previous tables. Respondents with high and average posttest scores preferred the Chimps to the Indians by margins of better than four-to-one and two-to-one. Low posttest respondents were almost evenly

split between the topics, with a slight edge given to the Indians.

Posttest Item Analysis

Item analysis helps to determine the reliability of test items by examining the indices of difficulty and discrimination for each item. Davis (1952) states that "The construction of solid and reliable tests requires consideration of quantitative information regarding the difficulty and discriminating power of each test exercise, or item, that is proposed for use. Such information is provided by item analysis data" (p. 97).

Tables 4.13 and 4.14 present the item analysis data for the passage and picture items on the Chimp posttest. Tables 4.15 and 4.16 present the item analysis data for the passage and picture items on the Indian posttest. The data for each posttest was based on a sample of 40 subjects. The researcher chose the 12 highest scores for the upper group and the 12 lowest scores for the lower group. Each group amounted to 30 percent of the total sample.

When we compare Tables 4.13 and 4.15, we find that the 30 passage items on the Chimp posttest had a mean index of discrimination of .51 to .42 for the Indian posttest. If we compare Tables 4.14 and 4.16, we find that the 20 picture items on the Chimp posttest had a mean index of discrimination of .43 to .40 for the Indian post-

Table 4.13 Item Analysis Data Based on Indices of Difficulty and Discrimination for 30 Items Based on the Passage Content from a Posttest on Wild Chimpanzees

Item Number	Index of Difficulty	Index of Discrimination	Item Number	Index of Difficulty	Index of Discrimination
1	.25	.33	16	.58	.50
2	.58	.33	17	.50	.33
3	.58	.67	18	.42	.83
4	.42	.67	19	.46	.75
5	.25	.50	20	.25	.50
6	.38	.58	21	.25	.50
7	.38	.58	22	.67	.50
8	.46	.41	23	.33	.67
9	.25	.33	24	.58	.33
10	.21	.41	25	.42	.83
11	.67	.33	26	.29	.58
12	.25	.33	27	.33	.55
13	.21	.41	28	.42	.50
14	.46	.58	29	.33	.50
15	.25	.33	30	.46	.58

Mean Index of Difficulty for 30 Items = .40

Mean Index of Discrimination for 30 Items = .51

Difficulty Desirability: Middle range items (about .40 to .60)
Discrimination Ratings: Reasonably good items (.30 to .39), Very good items (.40 and up)

Table 4.14 Item Analysis Data Based on Indices of Difficulty and Discrimination for 20 Items Based on the Picture Content from a Posttest on Wild Chimpanzees

Item Number	Index of Difficulty	Index of Discrimination	Item Number	Index of Difficulty	Index of Discrimination
31	.46	.41	41	.58	.50
32	.50	.50	42	.50	.33
33	.67	.50	43	.38	.25
34	.38	.41	44	.54	.75
35	.33	.33	45	.38	.41
36	.46	.41	46	.54	.58
37	.33	.33	47	.46	.41
38	.29	.41	48	.46	.41
39	.46	.41	49	.58	.50
40	.42	.33	50	.42	.33

Mean Index of Difficulty for 20 Items = .46

Mean Index of Discrimination for 20 Items = .43

Difficulty Desirability: Middle range items (about .40 to .60)
Discrimination Ratings: Marginal items (.20 to .29), Reasonably good items (.30 to .39), Very good items (.40 and up)

Table 4.15 Item Analysis Data Based on Indices of Difficulty and Discrimination for 30 Items Based on the Passage Content from a Posttest on Cliff Village Indians

Item Number	Index of Difficulty	Index of Discrimination	Item Number	Index of Difficulty	Index of Discrimination
1	.42	.33	16	.38	.41
2	.33	.33	17	.50	.67
3	.38	.41	18	.58	.50
4	.50	.33	19	.29	.41
5	.46	.41	20	.29	.41
6	.42	.33	21	.38	.41
7	.63	.41	22	.29	.41
8	.42	.33	23	.33	.33
9	.42	.50	24	.42	.50
10	.17	.33	25	.75	.50
11	.50	.33	26	.58	.50
12	.46	.41	27	.25	.33
13	.50	.33	28	.42	.50
14	.29	.41	29	.54	.41
15	.50	.83	30	.21	.25

Mean Index of Difficulty for 30 Items = .42

Mean Index of Discrimination for 30 Items = .42

Difficulty Desirability: Middle range items (about .40 to .60)
Discrimination Ratings: Marginal items (.20 to .29), Reasonably good items (.30 to .39), Very good items (.40 and up)

Table 4.16 Item Analysis Data Based on Indices of Difficulty and Discrimination for 20 Items Based on the Picture Content from a Posttest on Cliff Village Indians

Item Number	Index of Difficulty	Index of Discrimination	Item Number	Index of Difficulty	Index of Discrimination
31	.63	.41	41	.50	.50
32	.33	.33	42	.46	.41
33	.54	.58	43	.21	.25
34	.29	.41	44	.58	.50
35	.21	.41	45	.50	.67
36	.33	.33	46	.50	.67
37	.25	.33	47	.50	.33
38	.54	.25	48	.54	.25
39	.75	.33	49	.63	.41
40	.50	.33	50	.42	.33

Mean Index of Difficulty for 20 Items = .46

Mean Index of Discrimination for 20 Items = .40

Difficulty Desirability: Middle range items (about .40 to .60)
Discrimination Ratings: Marginal items (.20 to .29), Reasonably good items (.30 to .39), Very good items (.40 and up)

test. Based on this data, it would appear that the passage items had a somewhat higher test reliability than the picture items on both posttests.

If we combine the passage and picture items for each posttest, we find that the 50 items on the Chimp posttest had a mean index of discrimination of .48 to .41 for the Indian posttest. Ebel (1979) states that "Of two tests otherwise alike, the one in which the average index of item discrimination is the highest will always be the better, that is, the more reliable" (p. 267). Based on this criterion, the posttest on Chimps appears to have a somewhat higher reliability than the posttest on Indians. However, a spread of seven points between the Chimp and Indian mean discrimination scores calls for a cautious interpretation. As Mehrens and Lehmann (1978) suggest, "Item-analysis data should be interpreted with caution. Discriminating power is not analogous to item validity; the discrimination index is not always related to the quality of the item; and item-analysis data are very tentative" (p. 331).

The mean indices of discrimination for Tables 4.13, 4.14, 4.15, and 4.16 ranged from .40 to .51. Generally, a mean index of discrimination of .40 or above is considered very good (Ebel, 1979, p. 267).

If we combine the passage and picture items for each posttest, we find that the 50 items on the Chimp posttest had a mean index of difficulty of .42 to .44 for the

Indians. Items of average difficulty tend to maximize discrimination and test reliability. Items of middle difficulty should be favored in the construction of achievement tests (Ebel, 1979, p. 267).

Posttest Reliability Coefficients

The Kuder-Richardson Formula 20 is used to estimate the reliability of a single test that is based on interitem consistency and requires only a single administration (Kuder & Richardson, 1937). The K-R20 was appropriate for this study because it is designed for unspeeded tests and for items that are scored dichotomously. It requires information based on the number of items in the test, the variation of the total test, and the proportion of examinees passing each item.

Tables 4.17, 4.18, 4.19, and 4.20 present data for calculating reliability coefficients for the passage and picture content in each posttest. The first two columns show the distribution of scores and frequencies (F). The total frequency (n = 40) equals the number of students. The next four columns show the proportion of right (R) and wrong (W) answers for the 40 students. These proportions are given in fractions and decimals. To the right of the response proportions, a frequency (F) column indicates the number of items for each proportion. The column of item variances (pq) is computed by multiplying the proportion of right answers p(R) times the proportion of wrong an-

Table 4.17 Data for Calculating the Reliability (Kuder-Richardson Formula 20) of 30 Items Based on the Passage Content from a Posttest on Wild Chimpanzees

Score Distribution Score	F	R	Response Proportions W	p(R)	q(W)	F	Item Variances pq
28	1	34/40	6/40	.85	.15	1	.128
27	3	33/40	7/40	.825	.175	1	.144
26	3	32/40	8/40	.8	.2	2	.32
25	2	31/40	9/40	.775	.225	2	.349
24	3	30/40	10/40	.75	.25	1	.188
22	1	28/40	12/40	.7	.3	4	.84
21	5	27/40	13/40	.675	.325	2	.439
20	1	26/40	14/40	.65	.35	1	.228
19	4	25/40	15/40	.625	.375	3	.703
17	1	24/40	16/40	.6	.4	1	.24
16	3	23/40	17/40	.575	.425	1	.244
15	1	21/40	19/40	.525	.475	2	.249
14	1	20/40	20/40	.5	.5	2	.5
12	3	19/40	21/40	.475	.525	2	.499
11	4	18/40	22/40	.45	.55	3	.743
10	1	14/40	26/40	.35	.65	1	.228
8	2	13/40	27/40	.325	.675	1	.219
6	1					$k = \frac{1}{30}$	$\Sigma pq = 6.26$

$n = 40$

$\Sigma x = 738$

$\Sigma x^2 = 15168$

$s^2 = \frac{15168}{40} - \frac{738^2}{40^2} = 38.8$

(K-R20) $r = \frac{30}{30-1}\left[1 - \frac{6.26}{38.8}\right] = .87$

Table 4.18 Data for Calculating the Reliability (Kuder-Richardson Formula 20) of 20 Items Based on the Picture Content from a Posttest on Wild Chimpanzees

Score Distribution Score	F	R	Response Proportions W	p(R)	q(W)	F	Item Variances pq
18	2	30/40	10/40	.75	.25	1	.188
17	1	29/40	11/40	.725	.275	1	.199
16	1	26/40	14/40	.65	.35	3	.683
15	3	25/40	15/40	.625	.375	1	.234
14	3	24/40	16/40	.6	.4	2	.48
13	2	23/40	17/40	.575	.425	1	.244
12	4	21/40	19/40	.525	.475	2	.499
11	4	20/40	20/40	.5	.5	2	.5
10	5	19/40	21/40	.475	.525	2	.499
9	4	18/40	22/40	.45	.55	1	.248
8	2	17/40	23/40	.425	.575	1	.244
7	2	15/40	25/40	.375	.625	1	.234
6	4	14/40	26/40	.35	.65	1	.228
5	3	12/40	28/40	.3	.7	1	.21
	$n = \overline{40}$					$k = \overline{20}$	$\Sigma pq = \overline{4.69}$

$\Sigma x = 429$

$\Sigma x^2 = 5123$

$$s^2 = \frac{5123}{40} - \frac{429^2}{40^2} = 13.049$$

$$\text{(K-R20) } r = \frac{20}{20-1}\left[1 - \frac{4.69}{13.049}\right] = .68$$

(... Dicke ... Formula 30) of 30

Table 4.19 Data for Calculating the Reliability (Kuder-Richardson Formula 20) of 30 Items Based on the Passage Content from a Posttest on Cliff Indians

Score Distribution Score	F	R	Response Proportions W	p(R)	q(W)	F	Item Variances pq
27	1	34/40	6/40	.85	.15	2	.255
26	2	30/40	10/40	.75	.25	2	.375
25	1	29/40	11/40	.725	.275	1	.199
24	2	27/40	13/40	.675	.325	2	.439
23	2	26/40	14/40	.65	.35	3	.683
22	3	25/40	15/40	.625	.375	2	.469
21	2	24/40	16/40	.6	.4	3	.72
20	2	23/40	17/40	.575	.425	3	.733
19	2	21/40	19/40	.525	.475	5	1.247
18	3	19/40	21/40	.475	.525	1	.249
17	5	18/40	22/40	.45	.55	3	.743
16	2	17/40	23/40	.425	.575	1	.244
15	2	16/40	24/40	.4	.6	1	.24
13	2	12/40	28/40	.3	.7	1	.21
12	3					$k = \frac{1}{30}$	$\Sigma pq = \frac{.21}{6.81}$
11	1						
10	2	$\Sigma x = 703$		$s^2 = \frac{13451}{40} - \frac{703^2}{40^2} = 27.39$			
9	1	$\Sigma x^2 = 13451$					
8	2						
$n = \frac{2}{40}$				(K-R20) $r = \frac{30}{30-1}\left[1 - \frac{6.81}{27.39}\right] = .78$			

Table 4.20 Data for Calculating the Reliability (Kuder-Richardson Formula 20) of 20 Items Based on the Picture Content from a Posttest on Cliff Indians

Score Distribution Score	F	R	Response Proportions W	p(R)	q(W)	Item Variances F	pq
18	1	33/40	7/40	.825	.175	1	.144
17	1	30/40	10/40	.75	.25	1	.186
16	2	27/40	13/40	.675	.325	2	.439
15	2	25/40	15/40	.625	.375	1	.234
14	3	24/40	16/40	.6	.4	2	.48
13	4	23/40	17/40	.575	.425	2	.489
12	2	22/40	18/40	.55	.45	1	.248
11	5	21/40	19/40	.525	.475	2	.499
10	6	19/40	21/40	.475	.525	1	.249
9	1	17/40	23/40	.425	.575	2	.489
8	5	16/40	24/40	.4	.6	3	.72
7	3	15/40	25/40	.375	.625	1	.234
6	3	12/40	28/40	.3	.7	1	.21
5	2					k = 20	Σpq = 4.62
	n = 40						

$\Sigma x = 428$

$\Sigma x^2 = 5038$

$$s^2 = \frac{5038}{40} - \frac{428^2}{40^2} = 11.46$$

$$\text{(K-R20) } r = \frac{20}{20-1}\left[1 - \frac{4.62}{11.46}\right] = .63$$

swers q(W) times the frequency (F) of items. The sum of item variances (Σpq) is given at the bottom of the column. The column sums, along with the sum of squares and sum of squares squared, are entered into the K-R20 at the bottom of each table.

By comparing Tables 4.17 and 4.19, we find that the 30 passage items on the Chimp posttest had a reliability coefficient of .87 to .78 for the Indian posttest. A comparison of Tables 4.18 and 4.20 shows that the 20 picture items on the Chimp posttest had a reliability coefficient of .68 to .63 for the Indian posttest. Based on a comparison of the reliability coefficients, it is evident that the Chimp posttest had more reliability than the Indian posttest. It is also evident that the passage content in each posttest had higher reliability than the picture content. Chapter V will include a discussion based on the K-R20 results.

Treatment Observations

The researcher used a treatment chart to record the amount of time required by each student to complete a treatment. The number of minutes were recorded from the time the student began his treatment until he turned in the question sheet. The researcher also recorded the number of requests for assistance required by each student. Table 4.21 shows the mean treatment time and mean requests for assistance for each method and topic. Each of the 12

Table 4.21 Treatment Time and Requests for Assistance Means and Standard Deviations Based on 30 Observations Per Cell

		Wild Chimpanzees	Cave Indians	Row Means
Booklets	Treatment Time	Mean = 42.84 S.D. = 2.85	Mean = 43.18 S.D. = 2.92	43.01
	Requests for Assistance	Mean = 1.51 S.D. = 1.28	Mean = 1.38 S.D. = 1.22	1.45
Stationary Boards	Treatment Time	Mean = 44.50 S.D. = 1.96	Mean = 43.48 S.D. = 2.04	43.99
	Requests for Assistance	Mean = 1.44 S.D. = 1.32	Mean = 1.54 S.D. = 1.30	1.49
Manipulative Boards	Treatment Time	Mean = 44.92 S.D. = 2.01	Mean = 45.0 S.D. = 2.88	44.96
	Requests for Assistance	Mean = 1.62 S.D. = 1.37	Mean = 1.56 S.D. = 1.34	1.59
Column Means Treatment Time Requests for Assistance		44.09 1.52	43.89 1.49	

cells was based on 30 observations.

If we compare the treatment time cells for each method, we find that the booklets, stationary and manipulative boards were remarkably similar in the amount of time each one required. By comparing the row means for the treatment times, we find that the booklets took 43.01 minutes, the stationary boards required 43.99 minutes, and the manipulative boards required 44.96 minutes. The stationary boards required almost a minute more than the booklets, and the manipulative boards required almost a minute more than the stationary boards.

If we compare the treatment time cells for each topic, we find that the Chimps and Indians were remarkably similar in the amount of time each one required. By comparing the column means for the treatment times, we find that the Chimps required 44.09 minutes and the Indians 43.89 minutes.

When we compare the requests for assistance cells, shown in Table 4.21, we find very little variation among the methods or between the topics. By comparing the row means for the requests for assistance, we find that the booklets required 1.45 requests for assistance, the stationary boards 1.49, and the manipulative boards 1.59. By comparing the column means for the requests for assistance, we find that the Chimps required 1.52 requests for assistance and the Indians 1.49. These decimals indicate that each method and topic required approximately 1½ requests for assistance.

Question Sheet Analysis

Since the question sheets occupied a large portion of the treatment time, we may assume that they influenced the posttest results. Thus, it was important to construct each method and topic question form to the same structural specifications. While the Chimp and Indian question sheets were different in content, they were identical in length, form, and readability. For example, each question sheet had eight sentence completion questions based on passage

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Table 4.22 Question Sheet Means and Standard Deviations Based on 30 Observations Per Cell

		Wild Chimpanzees	Cave Indians	Row Means
Booklets	Passage Content	Mean = 7.13 S.D. = 1.14	Mean = 5.8 S.D. = 1.63	6.47
	Picture Content	Mean = 2.8 S.D. = .89	Mean = 2.4 S.D. = 1.07	2.6
Stationary Boards	Passage Content	Mean = 7.47 S.D. = 1.33	Mean = 6.47 S.D. = 1.31	6.97
	Picture Content	Mean = 3.3 S.D. = .96	Mean = 2.9 S.D. = .88	3.1
Manipulative Boards	Passage Content	Mean = 7.37 S.D. = 1.1	Mean = 6.43 S.D. = 1.74	6.9
	Picture Content	Mean = 3.1 S.D. = .99	Mean = 3.0 S.D. = .95	3.05
Column Means	Passages Pictures	7.32 3.07	6.23 2.77	

content and four multiple-choice questions based on picture content. (See Appendix C for examples of the question sheets.) According to the "Fry Readability Graph," the question sheets were between the fifth and sixth grade reading levels.

Table 4.22 shows the question sheet means and standard deviations based on the number of correct answers to the eight passage and four picture questions. It should be noted that the passage content means are substantially larger than the picture content means because there were twice as many passage questions.

When we compare the row means for the passage content, we find that there were 6.47 correct answers for the booklets, 6.97 for the stationary boards, and 6.9 for the manipulative boards. In terms of percentages, the booklets averaged 81%, the stationary boards 87%, and the manipulative boards 86%.

When we compare the column means for the passage content, we find that there were 7.32 correct answers for the Chimps and 6.23 for the Indians. In terms of percentages, the Chimps averaged 92% and the Indians 78%.

When we compare the row means for the picture content, we find that there were 2.6 correct answers for the booklets, 3.1 for the stationary boards, and 3.05 for the manipulative boards. In terms of percentages, the booklets averaged 65%, the stationary boards 78%, and the manipulative boards 76%.

When we compare the column means for the picture content, we find that there were 3.07 correct answers for the Chimps and 2.77 for the Indians. In terms of percentages, the Chimps averaged 77% and the Indians 69%.

Several trends emerge from the data in Table 4.22. First, the stationary and manipulative boards were higher than the booklets in both passage and picture scores, especially in the picture category. Second, there was a rather small difference between the boards in both passage and picture scores. Third, the Chimps were higher than

the Indians in passage and picture scores, especially in the passage category.

It should be noted that the question sheet trends for the methods and topics were similar to the posttest trends recorded in Tables 4.4 and 4.5. The one noticeable exception being that the posttest passage score for the booklets was higher than that for the manipulative boards.

Summary

A two-way MANOVA was performed on the posttest data from 180 subjects. The dependent variables (passage and picture posttest scores) were combined as a multivariate. The two independent variables included three methods and two topics.

The null hypothesis for interaction (methods by topics) was not rejected. There were two null hypotheses based on the methods and tested as two planned comparisons. The first null hypothesis for methods (booklets vs. stationary and manipulative boards) was rejected. The second null hypothesis for methods (stationary vs. manipulative boards) was not rejected. A null hypothesis based on the topics (Chimps vs. Indians) was rejected.

Since the MANOVA results led to the rejection of two null hypotheses, univariate F-tests, using two-way ANOVA models, were conducted to determine whether the passage and/or picture scores were significant. The first alternate hypothesis for methods (booklets vs. stationary

and manipulative boards) was significant for the picture scores only. An alternate hypothesis based on the topics was significant for the passage and picture scores.

A look at the mean scores indicated that each board outscored the booklet on picture content. The mean scores also indicated that the Chimps outscored the Indians on passage and picture content.

The student questionnaire data showed that the boards were preferred to the booklets by a two-to-one margin. The manipulative boards were preferred to the stationary boards by a three-to-one margin. The Chimps were preferred to the Indians by a two-to-one margin.

An analysis of the data indicated that both posttests had high mean indices of discrimination (item analysis) and reliability coefficients (Kuder-Richardson Formula 20). Furthermore, both posttests had similar picture and passage reliability coefficients.

The treatment observation data indicated that the methods and topics were remarkably similar in the amount of time each one required. The requests for assistance were remarkably similar for the methods and the topics.

The question sheet data showed that the boards produced higher mean scores than the booklets in both passage and picture content. The Chimps also scored higher than the Indians in both passage and picture content. These question sheet scores resembled the posttest scores.

CHAPTER V

CONCLUSIONS AND IMPLICATIONS FOR FUTURE RESEARCH

This chapter begins with a summary of the findings from the previous chapters. It also includes the following topics: Conclusions of the Study; Discussion of the Findings; and Implications for Future Research.

Summary

Statement of the Problem

The problem of this study focused on three questions. First, the study attempted to find out whether a simultaneous presentation of pictures and passages, as exemplified by the stationary and manipulative boards, would be more conducive to learning than a successive presentation of pictures and passages, as exemplified by the booklets. Second, the study attempted to find out whether the manipulative boards, which required the students to position the pictures above their appropriate passages, would be more conducive to learning than the stationary boards, which presented the pictures already mounted above their appropriate passages. Third, the study attempted to find out whether a topic of higher student interest would be more conducive to learning than

a topic of lower student interest for each of the treatments: booklets, stationary, and manipulative boards.

Need for the Study

The researcher was unable to locate any studies which attempted to compare the instructional effectiveness of a simultaneous presentation of pictures and passages to that of a successive presentation of pictures and passages. The researcher was unable to find any studies which attempted to compare the instructional effectiveness of a simultaneous and stationary set of pictures to that of a simultaneous and manipulative set of pictures. Finally, there was a need to examine whether higher versus lower student interest topics would influence the amount of learning associated with a successive and/or simultaneous presentation of pictures and passages.

Review of the Literature

A review of the literature indicated that a variety of learning principles, including simultaneity, proximity, and repetition among others, appeared to support a simultaneous format as opposed to a successive format of pictures and passages. While the instructional effectiveness of visual-tactual formats designed for upper elementary has not been determined, child developmental theory appeared to encourage multisensory learning. For example, Piagetian theory argued that as the child grows older, the

ability to coordinate and combine information from different sensory modalities also matures. Research on children's reading preferences has shown that animal topics are consistently more popular than topics based on people or cultures of long ago for all elementary grades.

Methodology and Design

The sample for this study consisted of 180 fifth grade students from two elementary schools in the Lansing School District of Michigan. The subjects were randomly assigned to six balanced groups: three methods (booklets, stationary, and manipulative boards) and two topics (Chimps and Indians).

The major research instruments were two 50 item multiple-choice posttests divided into 30 passage content items and 20 picture content items. The administration of the instruments was based on cued recall, written and delayed (two days after the treatments) responses. Half of the subjects were tested on Chimps and the other half were tested on Indians. A "Student Attitude Questionnaire" was also used to survey the preferences and reactions of the subjects to the methods and topics.

The major statistical model was a two-way MANOVA. The dependent variables (passage and picture posttest scores) were combined as a multivariate. Univariate F-tests, using two-way ANOVA models, were conducted to determine whether the passage and/or picture scores were

significant. The two-way MANOVA and ANOVAs included two Helmert planned comparisons based on the treatments.

The first null hypothesis stated that there would be no difference in the mean of the booklet group to each of the means associated with the stationary and manipulative board groups. The second null hypothesis stated that there would be no difference in the means associated with the stationary and manipulative board groups. The third null hypothesis stated that there would be no difference in the means associated with the higher-interest topic (Chimps) group and the lower-interest topic (Indians) group. For the test of significance, the alpha level was set at .05. To reject a null hypothesis, the test required a significant difference for at least one of the dependent variables: passage and/or picture content.

Analysis of the Data

The null hypothesis for interaction (methods by topics) was not rejected. The first null hypothesis for methods (booklets versus stationary and manipulative boards) was rejected. The first alternate hypothesis was significant for the picture scores only. A look at the mean scores revealed that each board outscored the booklet on picture content. The second null hypothesis for methods (stationary versus manipulative boards) was not rejected. A null hypothesis based on the topics (Chimps versus Indians) was rejected. The mean scores indicated

that the Chimps outscored the Indians on both dependent variables: passage and picture posttest scores.

The student questionnaire data revealed that the boards were preferred to the booklets by a two-to-one margin. The manipulative boards were preferred to the stationary boards by a three-to-one margin. The Chimps were preferred to the Indians by a two-to-one margin.

Conclusions of the Study

The conclusions in this section were derived from the results of the two-way MANOVA and ANOVA tests for significance. Each of the alternate hypotheses will be examined in turn.

The first alternate hypothesis (H_a1) stated that the means of the stationary and manipulative board groups would each exceed that of the booklet group. The two-way MANOVA found this hypothesis significant at .001. Subsequently, the two-way ANOVA models found this hypothesis nonsignificant for the passage variable but significant for the picture variable at .002. Since .002 was well below the assigned alpha level of .05, the researcher made the following observation. In regard to the picture posttest scores, each of the stationary and manipulative board groups was clearly superior to the booklet group. Thus, the conclusion was drawn that the simultaneous presentations of pictures and passages, as exemplified by the stationary and manipulative boards, were more conducive to

picture learning than the successive presentation of pictures and passages, as exemplified by the booklets.

It should be noted that the preceding conclusion applied to both topics (Chimps and Indians). Both topics scored significantly higher on the boards than on the booklets in terms of the picture content. Thus, the conclusion was drawn that the simultaneous presentations of pictures and passages, as exemplified by the stationary and manipulative boards, were more conducive to learning a higher and lower interest topic, in terms of the picture content, than the successive presentation of pictures and passages, as exemplified by the booklets.

The second alternate hypothesis (H_a2) stated that the mean of the manipulative board group would exceed that of the stationary board group. This hypothesis was not supported by the two-way MANOVA. Since .209 was well above the assigned alpha level of .05, the researcher made the following observation. In terms of the passage and picture posttest scores, there was no significant difference between the manipulative board group and the stationary board group. Thus, the conclusion was drawn that the manipulative boards, which required the students to position the pictures above their appropriate passages, were not more conducive to picture or passage learning than the stationary boards, which presented the pictures already positioned above their appropriate passages.

It should be noted that the preceding conclusion applied to both topics (Chimps and Indians). Neither topic scored significantly higher on the manipulative boards than on the stationary boards in terms of picture or passage learning. Thus, the conclusion was drawn that the manipulative boards, which required the students to position the pictures above their appropriate passages, were not more conducive to learning a higher or lower interest topic, in terms of picture or passage content, than the stationary boards, which presented the pictures already positioned above their appropriate passages.

The third alternate hypothesis (H_a3) stated that the mean of the higher interest topic (Chimps) group would exceed that of the lower interest topic (Indians) group. The two-way MANOVA found this hypothesis significant at .003. Subsequently, the two-way ANOVA tests found this hypothesis significant for the passage variable at .001 and at .017 for the picture variable. Since these significance levels were well below the assigned alpha level of .05, the researcher made the following observation. In regard to the passage and picture posttest scores, the higher interest topic (Chimps) group was clearly superior to the lower interest topic (Indians) group. Thus, the conclusion was drawn that the topic of higher student interest, as exemplified by the Chimps, was more conducive to passage and picture learning than the topic of lower

student interest, as exemplified by the Indians.

It should be noted that the preceding conclusion applied to all three methods (booklets, stationary, and manipulative boards). All three methods scored significantly higher on the topic of higher interest than the topic of lower interest in terms of picture and passage learning. Thus, the conclusion was drawn that the topic of higher student interest, as exemplified by the Chimps, was more conducive to picture and passage learning, for each of the three methods, than the topic of lower student interest, as exemplified by the Indians.

Discussion of the Findings

The discussion of the findings is divided into two subtopics. First, there is an assessment of the variables which may have accounted for the statistical results. Second, there is a discussion of the findings and their implications for educators and instructional designers.

Assessment of the Variables

In regard to the first alternate hypothesis, there were several variables which provide some tentative explanations as to why the picture means of the stationary and manipulative board groups exceeded that of the booklet group. First, the simultaneous presentation of pictures should have made it easier to analyze the visual content. Second, the attractive appearance of the stationary and

manipulative boards may have created greater motivation than the booklets. Third, the position of the question sheets, immediately in front of the boards, may have facilitated the location of picture information. The question sheets used with the boards did record higher picture scores, as reported in Table 4.22, than the question sheets associated with the booklets. Fourth, the novelty of the board treatments may have created a "Hawthorne Effect." For example, if the study had extended over a longer period of time, the students' preference for the boards may have increased, remained constant, or diminished in relation to the booklets.

The superior picture means of the board groups were consistent with the preferences expressed on the student questionnaires. For example, the stationary and manipulative boards were preferred by 67% to 33% over the booklets. The respondents also preferred to see all the pictures simultaneously rather than successively by 61% to 31%. These percentages indicate that the boards may have been more motivational than the booklets.

While the picture means of the board groups were significantly higher than that of the booklet group, the passage means proved to be nonsignificant. The simultaneous displays may have created a competitive atmosphere between the pictures and passages; that is to say, the pictures may have distracted the students' attention away from

the passages. Even if this competitive factor did influence the simultaneous displays, the passage means for the simultaneous presentations were still comparable to that of the successive presentation.

In regard to the second research hypothesis, there were several variables which provide some tentative explanations as to why the picture and passage means of the manipulative board group failed to exceed those of the stationary board group. First, the selecting and positioning of pictures above their appropriate passages may have distracted the students from the task of studying the picture and passage information. For example, to match the pictures and passages, the students had to look for particular cues. In the process of identifying the matching cues, the students may have skimmed over some important concepts. Second, the absence of any pretraining may have been an obstacle. This was the first time these students had worked with these visual-tactual materials. Third, since the positioning of the pictures was possibly the most motivational part of the lesson, the students may have approached the question sheets with less enthusiasm. Fourth, the instrumentation was not specifically designed to measure tactual learning. For example, none of the multiple-choice items asked the students to recall the positions of certain pictures or matching cues.

The nonsignificance of the picture and passage

means between the two board groups appeared inconsistent with the preferences expressed on the student questionnaires. For example, the students preferred to manipulate the pictures rather than work with stationary pictures by 74% to 26%. While these percentages indicate that the manipulative boards were probably more motivational than the stationary boards, the manipulative treatment was not strong enough to make a significant difference.

In regard to the third research hypothesis, there were several variables which provide some tentative explanations as to why the picture and passage means of the higher interest topic (Chimps) exceeded those of the lower interest topic (Indians). First, the literature indicated that children are more motivated by animal topics than early people topics. Also, recent studies have shown that students obtain more knowledge from higher than lower interest topics. Second, the pictures and passages associated with the Chimps might have been easier to organize and integrate. This may have been a result of the students' interest in the topical content and/or the possibility that the Chimps might have been more conducive to principles of visual perception and organization. Third, the literature indicated that children prefer eventful pictures with distinctive centers of interest. On the whole, the Chimps probably fulfilled these criteria more than the Indians.

The superior picture and passage means of the high-

er interest topic were consistent with the preferences expressed on the student questionnaires. For example, the Chimps were preferred by 68% to 32% over the Indians. The percentages suggest that the Chimps were probably more motivational than the Indians.

In assessing the variables which may have influenced the results of the research hypotheses, the validity of the instruments and treatments must be weighed. Both posttests conformed to the same structural specifications: that is, both tests had the same number of items, set of learning objectives, and reading levels. In addition to their parallel specifications, the validity of the tests was strengthened by their high and similar reliability coefficients and mean indices of discrimination. Therefore, it seems improbable that the lower scores associated with the Indian posttest were a result of structural inequalities between the two tests. It seems more probable that the lower scores were, in large part, a result of the lower topic interest.

In assessing the parallel nature of the treatments, the researcher recorded the amount of time required by each treatment. If one treatment had required substantially more time than the others, this increased exposure time might have influenced the posttest results and, subsequently, the conclusions drawn from the data. In Table 4.21, we found that each treatment required nearly the

same amount of time and requests for assistance. This data helped to substantiate the uniformity between the treatments in terms of difficulty and length.

Since the picture variable figured prominantly in the conclusions drawn from the first and third research hypotheses, a brief discussion of this dependent variable is in order. The analysis of the data, in Chapter IV, indicated that the picture variable had a lower reliability coefficient than the passage variable on both tests. In spite of the data, the reliability coefficients associated with the picture variable were high enough (68% for the Chimps and 63% for the Indians) to provide dependable group measurements. According to Mehrens and Lehmann (1978), "For group decisions, a reliability coefficient of about .65 may suffice" (p. 107).

Since the passage variable had 50% more items than the picture variable, this would tend to increase the reliability of the passage variable. Ebel (1979) observes that "Typically the reliability coefficient will be greater for scores from a longer test than a shorter test..." (p. 288). In summary, while the passage variable was more reliable than the picture variable, the latter had a high enough coefficient to justify conclusions based on group scores.

It should be noted that the discussion of the parallel structure of the posttests, while highly relevant to

the third research hypothesis, has little relevance to the first and second research hypotheses. In these tests, each posttest was measured across all three methods but not in relation to each other. Thus, the two posttests could have been unequal in structure while still providing meaningful data on the different methods.

Implications for Educators and Instructional Designers

This study provides some significant findings for educators and instructional designers. The conclusions suggest that a simultaneous presentation of pictures and passages may provide a significant supplement to the usual textbook presentation. The study provides support for Perrin's (1969) theory of multiple-image communication. It states "...that for making contrasts and comparisons, and for learning relationships, simultaneous images reduce the task of memory and enable the viewer to make immediate comparisons" (p. 376). Thus, if an educator wants to teach pictorial concepts, one should understand some basic perceptual and organizational principles for presenting simultaneous sets of pictures and passages.

The findings suggest that students need to be taught how to locate and analyze picture and passage information. If students are to be taught how to analyze letter sounds, why not teach them to analyze picture information? Fleming (1979) suggests that "Through much exposure to pictures, people not only become literate in reading pictures,

but in the process their way of thinking may be modified" (p. 243).

The findings of this study suggest that educators should identify students who are visually oriented and provide them with simultaneous picture-passage formats. Low verbal learners might also benefit from this technique. A simultaneous format might help to develop spatial and conceptual relationships, proportions, and visual perspective.

Educators should note that the students expressed a strong preference for the tactual materials, and that the manipulative boards did outscore the booklets in terms of picture content. For students who express an interest or a need for tactual and spatial development (eye-hand coordination), these materials could prove to be very beneficial.

This study suggests that educators might benefit by using simultaneous displays for topics of higher and lower interest, especially if the objective is to develop pictorial knowledge. Educators and instructional designers should try to select pictures which facilitate visual perception, organization, and conceptual comparisons. Since a topic of higher interest will probably outscore a topic of lower interest, it is important to be acquainted with the literature on children's topical interests and picture preferences. For example, this study would seem to suggest that children are attracted to anthropomorphic themes: that is, animals with human-like characteristics.

Implications for Future Research

Future visual research should investigate a variety of questions raised by simultaneous presentations of pictures and passages. In the case of the passages, there is a need to determine the optimum number, length, and difficulty of the passages. For example, at which point does the number, length, and difficulty of the passages begin to detract from their ability to convey information? Also, more research is needed for designing optimum verbal cues (referents) which link the passage to the picture. For example, the number and location of the passage cues need to be investigated. In the case of the pictures, how does the number, size, sequence, and complexity of the pictures contribute to learning?

Future researchers should explore which pictorial cues are relevant for different subject matter and which pictorial elements attract optimum attention. For example, the recording of eye movements from passages to pictures would help to determine the effectiveness of the cuing devices. These eye-span patterns and electromyographic recordings could provide insight into the child's direct information processing of simultaneous presentations of pictures and passages. Fleming (1969) states that "In sum, it does appear that the line-of-sight recording can become a very useful tool for research and practice in instructional media. EM (eye movement) data might be useful

in evaluating the designer's judgments and in testing the researcher's hypotheses" (p. 396).

Future research should examine the effectiveness of simultaneous displays using samples with various characteristics: such as, age, sex, socioeconomic groups, ability levels, and types of disabilities. For example, children with weak verbal skills might benefit from a visually-directed approach, like two of the formats used in this study. Levin, Divine-Hawkins, Kerst, and Guttmann (1974) found that subjects who learn relatively well from pictures but relatively poorly from words functioned like good learners when pictures were stressed. More pictorial and neurological testing could be used to identify students with high visual acuity. Future studies could be designed to test these students using visually-directed treatments.

The limitations of the study, in Chapter I, discussed the restricted nature of the instrumentation. For example, the posttests restricted the students to verbal choices (multiple-choice items). Future studies need to provide instruments for measuring visual responses, such as identifying and locating pictorial elements in a non-verbal format. For students who lack verbal skills, their visual recollections could be more accurately measured by visual identification tasks. The instruments were also restricted to cued, written, and delayed responses of two

days after the treatments. In future studies, the tests should include free, oral, and various response intervals: such as, immediate, a few days, a week, etc.

The discussion of the posttest instruments, in Chapter III, indicated that the picture and passage items were largely independent of each other. This meant that the picture questions could not be answered on the basis of passage retention or vice versa. While this made it easier to separate the dependent variables for purposes of measurement, this approach left out an important variable: namely, items based on picture-passage interdependence. Since the mutual cuing of pictures and passages was an important feature of the overall design, future instrumentation should experiment with items which require a combined knowledge of picture and passage content.

The instrumentation was based on cued (imposed) recall of information presented during the treatments. An induced strategy might lead to higher levels of picture and/or passage retention. This strategy calls for instructing the students to generate their own creative sets of images. Since the methods in this study imposed a set of pictures on the student, an induced strategy would instruct the student to construct some original images to serve as mediators for the existing pictures. Children could be instructed to use an interactive imagery strategy during encoding and reminded to use the mediators at testing. A

control group would not be given any imagery instructions. Pressley and Levin (1980) found that first and sixth graders did better when they were instructed to create internal interactive images than the children who were given no special instructions. However, it should be noted that the researchers began by showing the children words and not pictures. To ask children to induce pictures from an imposed set of simultaneous pictures would represent an untested strategy.

While the tactual dimension (manipulative board) did not outscore the visual dimension (stationary board), more research is needed to determine the merit of visual-tactual learning. The student characteristics and measuring instruments limited the generalizability of this study. For example, if the instruments had allowed for tactual measurements, the results may have been different. If the population had been composed of disabled or tactually-oriented children, the manipulative boards may have been more beneficial. Raskin and Baker (1975) state that "It appears that research is needed to determine whether young learning disabled children function more efficiently through vision, active touch, or the integration of both touch and vision" (p. 53).

While this study included some creative thinking at the end of each question sheet (see Appendix C), the post-tests were based, to a large extent, on the recall of pic-

ture and passage information. While the posttests also included analytic (comparing images) and synthetic (inferring generalizations) thinking, future instrumentation could be designed to measure more divergent and creative thinking.

The design recommendations in Chapter II would seem to suggest that researchers should examine: (1) Pretraining sessions for introducing students to simultaneous formats; and (2) An extended period of time and set of simultaneous formats for assessing student achievement and interest. Both of these procedures could train students on how to locate relevant features within and cues between the pictures and passages. Egeth and Wall (1972) found that pretraining and practice improved the retention span of multiple image displays. They used stimulus cards, with dots and letter patterns, to test parallel and simultaneous processing. After several days of practice, the classification of stimulus elements as numbers or letters could be carried out simultaneously and independently on up to six characters.

In summary, this study indicates that educators and instructional designers should probably devote more attention to the use of simultaneous presentations of visuals. Since the study appears to have drawn some significant conclusions and broken some new ground, further research is needed to corroborate and to enlarge upon these findings.

APPENDICES

APPENDIX A

THE RESEARCH INSTRUMENTS

Achievement Posttests
Student Attitude Questionnaires

Note: The materials in this appendix are 74% of the original size.

NAME _____

DATE _____

HOMEROOM
TEACHER _____

TEST ON THE LIVING HABITS OF WILD CHIMPANZEES

Directions: Choose the best answer to each question. Then draw a circle around the letter in front of your answer. Try to answer every question.

Sample Question:

Scientists consider wild chimps to be

a. Less intelligent than many animals

b. As intelligent as most animals

(c.) One of the most intelligent animals

d. As intelligent as human beings

1. Wild chimps live in a park in

   a. Upper Africa

   b. Lower Africa

   c. Central Africa

   d. Coastal Africa

2. How long did the lady scientist have to wait before she could get close enough to the chimps to feed them?

   a. Several days

   b. Several weeks

   c. Several months

   d. About one year

---

3. When chimps get excited, they usually

   a. Slap the ground and rush about

   b. Wave sticks and chase each other

   c. Jump up and down and wave their arms

   d. Climb trees and swing from branches

4. A chimp's language consists mainly of

   a. A few simple words

   b. Drawings on the ground

   c. Imitations of other animals

   d. Low hoots and grunts

---

5. Chimps like to steal cloth from tents to

   a. Keep them warm and dry

   b. Chew and suck on

   c. Use as a rope

   d. Make their tree nests

6. In the jungle, how would a chimp usually act around a strange person?

   a. He gets excited and runs about

   b. He does not pay much attention

   c. He would be afraid to come close

   d. If you have food, he will come close

---

7. Wild chimps are called <u>nomads</u> because they

   a. Prefer to live in small groups

   b. Travel about with no permanent home

   c. Remain peaceful and seldom get angry

   d. Prefer to live in the jungle

8. If a chimp travels very far in search of food, he usually hunts

   a. Alone (by himself)

   b. With one other friend

   c. In a small group

   d. In a large group

9. A newborn chimp is

   a. Able to climb in about a month

   b. Almost strong enough to stand up

   c. Much stronger than a human baby

   d. Helpless for several months

10. Which of these statements is true of baby chimps? They

   a. Cry just like human babies

   b. Are raised on their mother's milk

   c. Do not suck their thumbs

   d. Are born with a set of teeth

---

11. Newborn chimps sleep with their mothers for about

   a. Three months

   b. Six months

   c. One year

   d. Three years

12. Baby chimps hang on to their mothers by

   a. Gripping their hair

   b. Hanging on to their tails

   c. Holding on to their necks

   d. Riding on their shoulders

---

13. Raising a baby chimp is usually

   a. The mother's responsibility

   b. The father's responsibility

   c. Shared by both parents

   d. Shared by several mothers

14. The word <u>extinct</u> means

   a. Trying to protect animals

   b. Having died out

   c. Having a strong desire

   d. Having a special ability

---

15. Wild chimps are mostly <u>herbivorous</u>. This means they

   a. Eat almost anything they find

   b. Eat a balance of plants and meat

   c. Feed mostly on meat

   d. Feed mostly on plants

16. When chimps walk upright, it is often because they want to

   a. Give their hands a rest

   b. Hold something in their hands

   c. Scare each other away

   d. Pretend that they are humans

---

17. Scientists think chimps clean each other because they like to

   a. Stay very clean and healthy

   b. Show affection for each other

   c. Look very attractive

   d. Keep their hands busy

18. The word <u>socialization</u> describes

   a. How chimps learn to cooperate

   b. How chimps behave like humans

   c. Why chimps are so intelligent

   d. Why scientists study chimps

19. Scientists are very interested in chimps because they

a. Are fun to watch

b. Can teach us many skills

c. Can walk like humans

d. Help us to understand early man

20. The average life span of a chimp is about

a. 20 years

b. 45 years

c. 65 years

d. 90 years

---

21. Scientists think chimps perform rain dances because they

a. Like to scream and wave branches

b. Like to climb and run down hills

c. Are scared of loud noises

d. Are trying to entertain each other

22. What do male chimps do during their rain dance?

a. Beat branches on the ground

b. Chase each other with branches

c. Wave branches at the females

d. Run down hills and climb trees

---

23. What do female chimps do during a thunderstorm?

a. Swing from branch-to-branch

b. Sit on branches and scream

c. Throw things from trees

d. Cover their eyes and ears

24. The main interest of a <u>zoologist</u> is to study

a. How animals live in the jungle

b. The behavior of the ape family

c. How animals live in the zoo

d. The living habits of animals

---

25. The lady scientist wanted to live with chimps to

a. Teach them some special skills

b. Find out if they are friendly

c. Learn how to live in the jungle

d. Observe and record their daily behavior

26. Chimps poke stems into termite mounds because they are trying to

a. Scare and surprise the termites

b. Find out how deep the holes are

c. Get the termites to craw on the stems

d. Keep the termites from getting out

---

27. Chimps catch termites on stems because they

a. Like the taste of them

b. Like to tease them

c. Want to play with them

d. Want to look at them

28. A chimp makes a sleeping nest by

a. Tying several branches together

b. Spreading grass over the branches

c. Bending and interweaving branches

d. Making a frame from broken branches

29. How long does it take a chimp to construct a tree nest?

a. One minute

b. Few minutes

c. Ten minutes

d. Twenty minutes

30. The word <u>adapt</u> means to

a. Be very skillful at climbing

b. Be very skillful at making tools

c. Add a new child to the family

d. Adjust your behavior to the environment

Directions; All of the following questions are based on the 12 pictures in the lesson. Try to remember the picture content as you answer each question. Draw a circle around the correct letter. Try to answer every question.

---

31. One picture shows a lady and a chimp standing beside each other. It looks like the

a. Lady and chimp are both holding some bananas

b. Chimp is holding the bananas by himself

c. Lady is holding the bananas by herself

32. Based on the same picture, it looks like a full grown chimp

a. Is about as tall as a woman

b. Can stand as straight as a woman

c. Has longer arms than a woman

---

33. Another picture shows a chimp walking away from a tent on all fours. It looks like he bends his

a. Legs more than his arms

b. Arms more than his legs

c. Arms and legs about the same

34. In the same picture, the people in front of the tent seem to be

a. Trying to scare the chimp away

b. Watching the chimp walk away

c. Offering food to the chimp

---

35. Based on several pictures, we could say that a chimp's

a. Legs are longer than his arms

b. Arms are longer than his legs

c. Arms and legs are the same length

36. One picture shows a lady watching four chimps on a branch

a. Play with each other

b. Clean each other

c. Follow each other

---

37. In the same picture, the lady is watching the chimps through

a. A telescope (one tube)

b. Binoculars (two tubes)

c. A camera (taking photographs)

38. Based on several pictures, it looks like chimps have very

a. Short necks

b. Large foreheads

c. Small heads

39. One picture shows a child hanging to its mother. The child is hanging from the mother's

    a. Side

    b. Front

    c. Back

40. Based on several pictures, it looks like chimps have small

    a. Legs compared to humans

    b. Arms compared to humans

    c. Hands and feet compared to humans

---

41. The upper part of the chimp's body, from the waist up, is

    a. Small compared to a human

    b. Large compared to a human

    c. About the same as a human

42. How is a chimp's face different from a human face?

    a. His whole face is much flatter

    b. The lower part sticks out farther

    c. The upper part sticks out farther

---

43. One picture shows six chimps on the ground. What are they doing?

    a. Eating grass and bananas

    b. Playing with several children

    c. Cleaning and holding each other

44. One picture shows a close-up of a chimp seated on the ground with a hand full of bananas. He is also

    a. Eating one of the bananas

    b. Resting his arm on his knee

    c. Resting his chin on his hand

---

45. In the same picture, the chimp seems to be looking at

    a. The banana in his hand

    b. The camera in front of him

    c. Something in the distance

46. In another picture, a chimp is touching the lady scientist. It looks like he is touching her

    a. Hand

    b. Arm

    c. Neck

---

47. Next to the lady and the chimp, two chimps are standing on a branch and

    a. They seem to be hugging each other

    b. They seem to be playing a game

    c. One seems to be cleaning the other

48. One picture shows three chimps poking stems into termite mounds. In the picture,

    a. One chimp is using both hands to hold his stem

    b. Two chimps are using both hands to hold their stems

    c. All three chimps are using both hands to hold their stems

49. The chimps are sitting next to a termite mound. The mound looks

    a. Much smaller than the chimps

    b. About as tall as the chimps

    c. Much taller than the chimps

50. Another picture shows three chimps relaxing on branches. The chimps are resting

    a. On their backs

    b. On their stomachs

    c. In several positions

Important: Before you turn in this test, make sure you circled one letter answer for every question.

NAME _____

DATE _____

HOMEROOM
TEACHER _____

TEST ON CLIFF VILLAGE INDIANS OF EARLY AMERICA

Directions: Choose the best answer to each question. Then draw a circle around the letter in front of your answer. Try to answer every question.

Sample Question:

Indians of early America
built cliff villages about

a. 200 years ago

b. 400 years ago

(c.) 700 years ago

d. 1400 years ago

1. The Indian caves are located on the sides of cliffs with a

   a. Plateau above and a plain below

   b. Plateau above and a valley below

   c. Lake above and a valley below

   d. Lake above and a plain below

2. The large cliffs are made from

   a. Granite

   b. Marble

   c. Limestone

   d. Sandstone

---

3. The word prehistoric means the time before

   a. Man lived on the earth

   b. The earth was made

   c. Man made written records

   d. Scientists began exploring caves

4. A kiva was a round room used as a

   a. Workshop and religious room

   b. Workshop and storage room

   c. Meeting place and religious room

   d. Meeting place and storage room

---

5. Some kivas were used to bury dead persons along with tools and

   a. Pots of food

   b. Pots of gold

   c. Jewelry

   d. Dead animals

6. Indians climbed from their cave villages to the top of the cliff by using

   a. Steps carved in the rocks

   b. Ladders tied to the rocks

   c. Ropes tied to the rocks

   d. Footholes carved in the rocks

---

7. To supply water to grow their food, the Cave Indians designed

   a. A system of pumps

   b. Irrigation ditches

   c. Water wheels

   d. Clay pipes

8. One caption describes a deer hunt. The deer hunters are using

   a. Spears and rocks

   b. Spears and slingshots

   c. Arrows and rocks

   d. Arrows and slingshots

---

9. The hole in the floor of the kiva was suppose to

   a. Lead to another room

   b. Lead to the spirit world

   c. Be used to store tools

   d. Be used for building fires

10. The smoke inside the kiva was suppose to

    a. Attract friendly spirits

    b. Keep out evil spirits

    c. Carry prayers to heaven

    d. Send messages between spirits

11. How did the Cave Indians use deer sinews (fiber tissue)? They were

    a. Wrapped together to make ropes

    b. Woven together to make clothes

    c. Used as thread and bowstrings

    d. Used to tie ladders together

12. Scientists think the main reason the Indians lived in caves was to

    a. Protect themselves from enemies

    b. Provide protection from the weather

    c. Hide from their enemies

    d. Store their supplies of food and water

---

13. The Indians probably moved out of these caves because

    a. Of a shortage of food and water

    b. It was dangerous to climb the cliffs

    c. Most of the Indians died from disease

    d. The villages became too crowded

14. Archaeologists are scientists who are mainly interested in

    a. Studying villages inside arches and caves

    b. Studying prehistoric Indians

    c. Studying the life and culture of early peoples

    d. Collecting artifacts for their art value

---

15. By studying human skeletons, scientists have learned that Cave Indians

    a. Were as tall as modern man

    b. Suffered from bone diseases

    c. Lived to be about 60 years old

    d. Were stronger than modern man

16. The main reason the scientists studied the logs was to determine

    a. Where the wood came from

    b. What kind of wood was used

    c. How the rooms were built

    d. The age of the village

---

17. The word pueblo refers to houses built

    a. Inside large caves

    b. With a round shape

    c. On top of each other

    d. With many ladders

18. Before these Indians moved inside caves, scientists think they lived

    a. On mountain tops

    b. On the flat plains

    c. In forest valleys

    d. In lake regions

19. Ladders were often used instead of steps and doors because they

a. Were easier to construct than steps

b. Were very useful in case of fires

c. Could be moved from one house to another

d. Could be pulled up if the enemy attacked

20. To an archaeologist, the word <u>excavate</u> means to

a. Uncover objects by digging

b. Build at a higher elevation

c. Rebuild old settlements

d. Bury objects with the dead

---

21. Why did the Cave Indians spread ears of corn on rooftops?

a. To protect them from mice

b. As an offering to the gods

c. To dry them in the sun

d. To decorate their villages

22. The pictures of early Cave Indians come from

a. Photographs taken long ago

b. Photographs of clay models

c. Paintings by early Indians

d. Paintings by modern artists

---

23. To make their clay pots strong, Indians added

a. Sand and plant stems

b. Sand and crushed rocks

c. Glue and crushed rocks

d. Glue and plant stems

24. Why are scientists especially interested in artifacts? They want to

a. Collect facts about Indian life

b. Learn to recognize old objects

c. Learn about early cultures

d. Learn how old handicrafts were made

---

25. Which one of these choices is true about making baskets? They

a. Required some simple tools

b. Required two Indians helping each other

c. Were made by the cave women

d. Were made in a day or two

26. In making an Indian belt, why are the threads wrapped around five pegs?

a. To stretch and separate them

b. To weave them together

c. To measure their length

d. To divide them into five parts

27. Early Indians hung their shoes (moccasins) from the ceiling to

a. Keep them from getting dirty

b. Prevent children from playing with them

c. Provide more space to work on crafts

d. Protect them from mice

28. To say that Cave Indians were <u>interdependent</u>, means

a. They had different responsibilities

b. Only village members could enter the cave

c. Each Indian was free and independent

d. They needed and helped each other

---

29. The population of a large cave village was about

a. 200 Indians

b. 400 Indians

c. 800 Indians

d. 1000 Indians

30. The lesson described how young children helped their

a. Mothers make pottery

b. Mothers collect water

c. Fathers make baskets

d. Fathers grow food

Directions: All of the following questions are based on the 12 pictures in the lesson. Try to remember the picture content as you answer each question. Draw a circle around the correct letter. Try to answer every question.

---

31. One picture shows two women tourists exploring a cave village. It looks like most of the

a. Walls are still standing

b. Upper walls are missing

c. Walls are piled on the ground

32. Based on the same picture, about how many feet is it from the village to the top of the cliff?

a. About fifty feet

b. Several hundred feet

c. About one thousand feet

---

33. On the ceiling of the cave, you can see

a. Drawings of Indians

b. Drawings of animals

c. Black stripes

34. One picture looks down into a kiva. We can see that the walls are made of

a. Bricks made from clay

b. Stones stuck together

c. Logs stacked on each other

---

35. Two pictures show the floor of a kiva. The floor is made of

a. Flat stones

b. Flat boards

c. Smooth clay

36. Based on the paintings, it looks like cave women

a. Liked to wear necklaces

b. Wore very little jewelry

c. Painted parts of their bodies

37. Based on several pictures, it looks like the village walls were made of mostly

    a. Bricks and stones

    b. Bricks and logs

    c. Bricks, stones, and logs

38. One picture shows two women climbing to the top of the cliff. As they approach the top,

    a. One is on a narrow trail and the other is using footholes

    b. They are both walking along the narrow trail

    c. They are both climbing the footholes

---

39. In the same picture, how are the women carrying their pots?

    a. In their hands

    b. On their heads

    c. One by hand and one on the head

40. Based on several pictures, it looks like the scientists decided to

    a. Rebuild many parts of the village

    b. Rebuild almost all of the village

    c. Leave the village the way they found it

---

41. One painting shows two men working inside a kiva with a woman on a ladder. The ladder stands

    a. Close to the wall of the kiva

    b. Straight up in the middle of the room

    c. At an angle near the middle of the room

42. The wall of the round kiva has a series of

    a. Tunnels at the floor level

    b. Clay shelves shaped like windows

    c. Wood shelves for holding pottery

---

43. One painting shows a hunter bringing a deer into a cave. How is he transporting the deer?

    a. By carrying the deer on his back

    b. By dragging the deer by the leg

    c. By carrying the deer on a pole

44. In the same painting, an old lady with white hair is

    a. Holding a cup in her hands

    b. Stirring a pot over a fire

    c. Wrapping herself in a blanket

---

45. One large painting shows many Indians working inside a cave. Most of the Indians are working

    a. In front of the houses

    b. While standing on ladders

    c. While standing on rooftops

46. The same painting shows that most of the buildings

    a. Were one story high

    b. Had flat rooftops

    c. Did not have windows

47. Based on the same painting, it appears that the cliff village

    a. Did not have any round shaped towers

    b. Had at least one round shaped tower

    c. Had many round shaped towers

48. One picture shows a modern Indian woman making bread and pottery. What is she wearing?

    a. Traditional Indian clothes

    b. Cloth wrapped around her legs

    c. Indian bracelets on her arms

---

49. One picture shows many examples of painted pottery. Cave Indians usually painted

    a. Just the outside of the pottery

    b. Pictures of animals and Indians

    c. Black lines on white backgrounds

50. One picture shows modern Indian man making handicrafts. What are the two men wearing on their heads?

    a. Cloth headbands

    b. Feather headbands

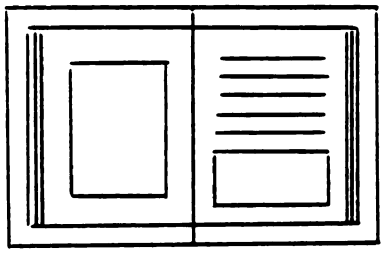
    c. Cowboy style hats

Important: Before you turn in this test, make sure you circled one letter answer for every question.

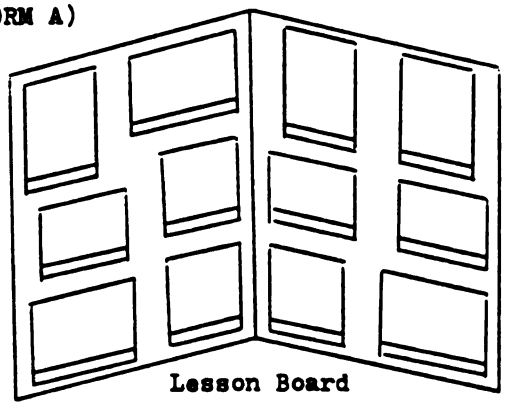
Name _____

STUDENT ATTITUDE QUESTIONNAIRE

(FORM A)



Lesson Book



Lesson Board

You have just completed two lessons. In one lesson, you used a book with 12 pictures and captions. In the other lesson, you used a board with 12 pictures and captions.

1. Did you like one style better than the other? (Check one of the three boxes below)

☐ I liked the book style the most

☐ I liked the board style the most

☐ I did not like one style more than the other

2. Did you like one picture style better than the other? (Check one of the three boxes below)

☐ I like to see the pictures page-by-page

☐ I like to see all the pictures in front of me

☐ I don't prefer one style over the other

3. Did you find one style had easier directions to understand than the other? (Check one of the three boxes below)

☐ I found the book easier to understand

☐ I found the board easier to understand

☐ I didn't think one style was any easier

4. Did you find one subject (Chimps or Indians) more interesting than the other? (Check one of the three boxes below)

☐ I enjoyed the wild chimps the most

☐ I enjoyed the Cave Indians the most

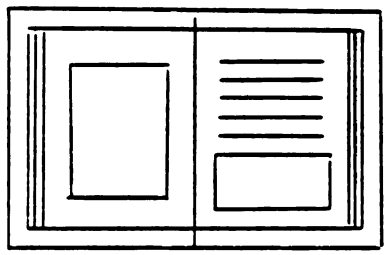
☐ I didn't enjoy one subject more than the other

If you can think of a reason(s) for choosing chimps or Indians, please write it on the back of this paper.

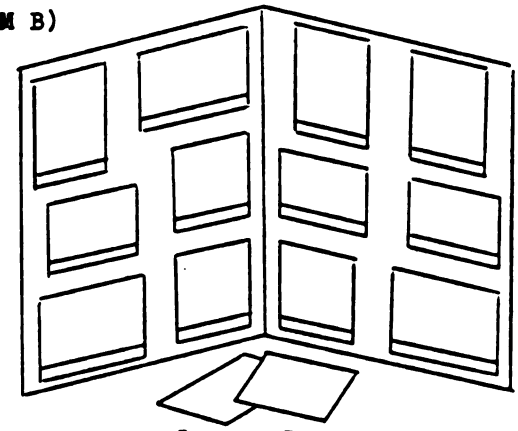
Name _____

STUDENT ATTITUDE QUESTIONNAIRE

(FORM B)



Lesson Book



Lesson Board

You have just completed two lessons. In one lesson, you used a book with 12 pictures and captions. In the other lesson, you used a board with 12 pictures and captions. You had to place the pictures on the board.

1. Did you like one style better than the other? (Check one of the three boxes below)

☐ I liked the book style the most

☐ I liked the board style the most

☐ I did not like one style more than the other

2. Did you like one picture style better than the other? (Check one of the three boxes below)

☐ I like to see the pictures page-by-page

☐ I like to see all the pictures in front of me

☐ I don't prefer one style over the other

3. Did you find one style had easier directions to understand than the other? (Check one of the boxes below)

☐ I found the book easier to understand

☐ I found the board easier to understand

☐ I didn't think one style was any easier

4. Did you find one subject (chimps or Indians) more interesting than the other? (Check one of the three boxes below)

☐ I enjoyed the wild chimps the most

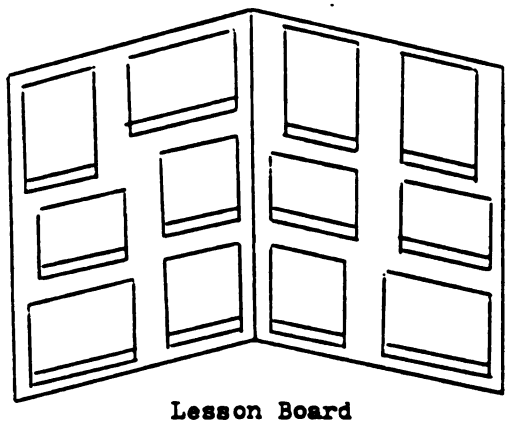
☐ I enjoyed the Cave Indians the most

☐ I didn't enjoy one subject more than the other

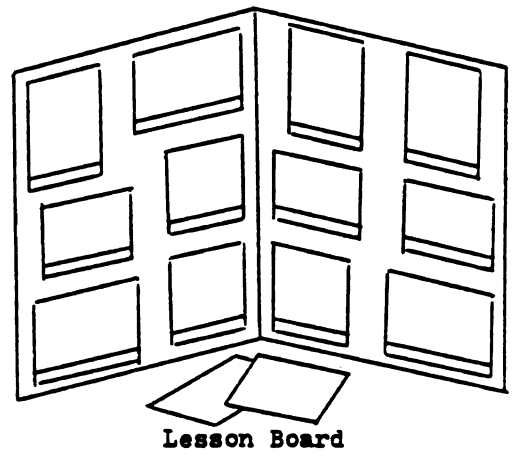
If you can think of a reason(s) for choosing Chimps or Indians, please wrie it on the back of this paper.

Name _____

STUDENT ATTITUDE QUESTIONNAIRE
(FORM C)



Lesson Board



Lesson Board

You have just completed two lessons. In one lesson, you used a board with pictures already on it. In the other lesson, you had to place the pictures on the board. Both lessons had 12 pictures and captions.

1. Did you like one board style better than the other? (Check one of the three boxes below)

☐ I prefer the board with the pictures already on it

☐ I prefer to place the pictures on the board

☐ I didn't prefer one board more than the other

2. Did you find that one board had easier directions to understand than the other? (Check one of the three boxes below)

☐ I found the board with the pictures already on it easier to understand

☐ I found that putting the pictures on the board was easier to understand

☐ I didn't find one board easier to understand than the other

3. Did you find one subject (Chimps or Indians) more interesting than the other? (Check one of the three boxes below)

☐ I enjoyed the Wild Chimps the most

☐ I enjoyed the Cave Indians the most

☐ I didn't enjoy one subject more than the other

If you can think of a reason(s) for choosing Chimps or Indians, please write it on the back of this paper.

APPENDIX B

ITEM IDENTIFICATION TABLES

Distribution of Posttest Items
Item Answer and Reference Keys

Note: The materials in this appendix are 74% of the original size.

TABLE A.1 Two-Way Distribution of Items for an Achievement Test on Wild Chimpanzees

TEST CONTENT CATEGORIES	LEARNING OBJECTIVES BASED ON QUESTIONS				
	Caption Content Categories		Picture Content Categories		
	1. Recalling Factual Information and Defining Terminology	2. Understanding Conceptual Relationships and Generalizations	1. Understanding Conceptual Relationships Based on Image Recall	2. Comparing Objects Within and/or Between Pictures Based on Image Recall	Total Number of Items for Each Content Category
1. Individual and Group Behavior of Grown Chimps	18	3, 5, 8, 22, 23	43, 45, 47		9
2. Parental Raising and Characteristics of Young Chimps	9, 11	10, 12, 13	39		6
3. Physical Features and Characteristics of Grown Chimps	20	4, 16	44	33, 35, 38, 48, 49	9
4. References to Scientists or Zoologists (Observations)	2, 24	17, 21, 25	36, 37, 46		8
5. Comparisons and Interaction Between Chimps and Humans		6, 19	31, 34	32, 40, 41, 42	8
6. Adapting to and Shaping the Habitat to Meet Basic Needs	1, 7, 14, 15, 29, 30	26, 27, 28		50	10
Total Number of Items for Each Learning Objective	12	18	10	10	50

The test item numbers are given in each cell. A description of the underlying concepts for each item is found on the following pages.

TABLE A.2 Two-Way Distribution of Items for an Achievement Test on Cliff Village Indians

TEST CONTENT CATEGORIES	LEARNING OBJECTIVES BASED ON QUESTIONS: Caption Content Categories: 1. Recalling Factual Information and Defining Terminology	Caption Content Categories: 2. Understanding Conceptual Relationships and Generalizations	Picture Content Categories: 1. Understanding Conceptual Relationships Based on Image Recall	Picture Content Categories: 2. Comparing Objects Within and/or Between Pictures Based on Image Recall	Total Number of Items for Each Content Category
1. Roles and Responsibilities of Village Members for Fulfilling Basic Needs	8, 28	11, 21 27, 30	43, 44 48	39	10
2. References to Scientists or Archaeologists (Observations)	3, 14 20	12, 13 15, 16 18, 24		40	10
3. Basic Design and Construction of Villages (Dimensions/ Materials)	17, 29	19	31	37, 45 46, 47	8
4. Cliff Village Kivas (Basic Construction and Living Purposes)	4, 5	9, 10	34, 35 41, 42		8
5. Natural and Man-Made Features Near the Village (Cliffs, Footholes, etc.)	1, 2	6, 7	33	32, 38	7
6. Indian Handicrafts and Artifacts (Baskets, Pottery, etc.)	23	22, 25 26	36, 49 50		7
Total Number of Items for Each Learning Objective	12	18	12	8	50

A description of the underlying concepts for each item is found on the following pages.

Table A.3 Item Answer and Reference Key for a Posttest on Wild Chimpanzees

Question Number	Letter Answer	Caption Reference	Question Number	Letter Answer	Picture Reference
1	C	1	31	A	1
2	C	1	32	C	1
3	A	3	33	A	3
4	D	3	34	B	3
5	B	3	35	B	Several
6	C	3	36	C	2
7	B	2	37	B	2
8	C	2	38	A	Several
9	D	4	39	A	6
10	B	4	40	A	Several
11	D	4	41	B	Several
12	A	6	42	B	Several
13	A	6	43	C	9
14	B	6	44	B	8
15	D	5	45	C	8
16	B	5	46	C	10
17	B	9	47	C	10
18	A	9	48	A	12
19	D	8	49	B	12
20	B	8	50	C	11
21	C	7			
22	A	7			
23	B	7			
24	D	10			
25	D	10			
26	C	12			
27	A	12			
28	C	11			
29	B	11			
30	D	11			

Table A.4 Item Answer and Reference Key for a Posttest on Cliff Village Indians

Question Number	Letter Answer	Caption Reference	Question Number	Letter Answer	Picture Reference
1	B	1	31	B	1
2	D	1	32	B	1
3	C	1	33	C	1
4	A	3	34	A	3
5	A	3	35	C	3, 4
6	D	2	36	B	Several
7	B	2	37	A	Several
8	C	2	38	A	2
9	B	4	39	C	2
10	B	4	40	A	Several
11	C	6	41	C	4
12	A	6	42	B	4
13	A	6	43	A	6
14	C	5	44	A	6
15	B	5	45	C	8, 9
16	D	5	46	B	8, 9
17	C	9	47	B	8, 9
18	B	9	48	B	7
19	D	9	49	C	10
20	A	8	50	A	12
21	C	8			
22	D	8			
23	B	10			
24	C	10			
25	A	12			
26	A	12			
27	D	12			
28	D	11			
29	B	11			
30	A	11			

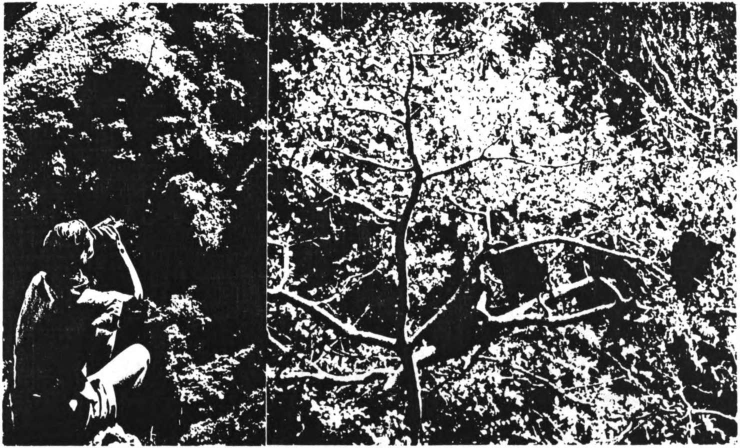
APPENDIX C

THE TREATMENT MATERIALS

Pictures and Captions
Question Sheets

Note: The pictures in this appendix have been reduced to 86% of their original size. The original pictures used in the study were in color and they provided much more detail than these black-and-white, high contrast photocopies. The written passages in this appendix are 74% of the original size.

Caption 1. Wild chimpanzees live in central Africa. Chimps have been living here for thousands of years, even before caveman first lived on earth. Scientists have decided that apes are man's closest relatives in the animal world. We know that the earliest caveman looked very much like these apes. This lady went to Africa to study the behavior of wild chimps. She had to be very patient for several months before they let her get close enough to feed them.



Caption 2. Wild chimps live on the grassy ridges and valleys in a tropical rain forest. They like to travel and hunt for food in small groups. They may hunt together for a few hours or a few days. Since they travel long distances in search of food, we say they are nomadic hunters. Nomads are humans or animals who have no permanent home and move about constantly in search of food and shelter. When chimp groups meet each other, they call loudly and shake the tree branches. Sometimes, a few chimps will change groups. This lady is observing their group behavior.

Caption 3. Wild chimps are usually very shy around humans. This chimp is trying to steal some food or cloth from a tent. They like to chew and suck on cloth. Chimps are usually peaceful animals. They seldom try to hurt each other or humans. If a chimpanzee becomes excited or scared, he may become dangerous because of his strong arms. When they are excited, they throw rocks, slap the ground, and rush about dragging sticks. Their language includes hand and arm gestures, loud screams of excitement, and low sounding hoots and grunts.

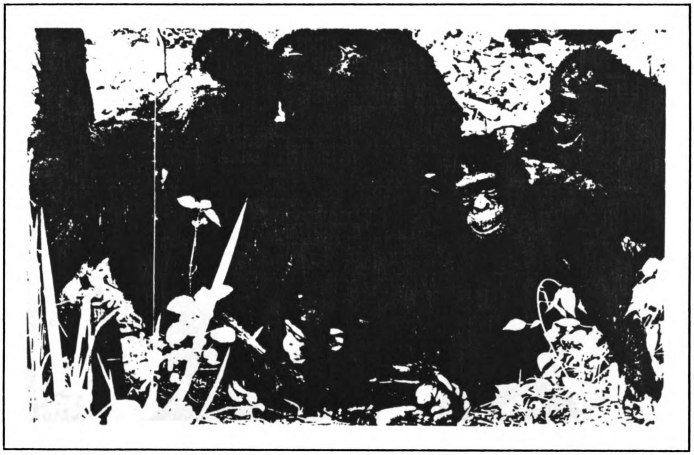
Caption 4. A newborn chimp is as helpless as a human baby and never leaves its mother for the first four months. Small chimps sleep with their mothers until they are about three years old. Like human babies, chimps are raised on their mother's milk and they suck their thumbs until they develop teeth. These parents are expressing their love and protection for their baby. Grown-up chimps like to play games and tickle their young children.

Caption 5. Chimpanzees spend many hours each day locating and eating food. They may travel as many as ten miles in a day depending on the seasonal supply of fruits, leaves, seeds, blossoms, stems, bark, and nuts. Since they usually eat plants, we say they are mostly herbivorous (feeding chiefly on grass and other plants). Chimps do eat some meat, like small monkeys, pigs, and even termites. The chimp on the right has just stolen some bananas. He will eat the entire banana--skin and all. The picture shows that chimps can walk standing up as well as on all fours.

Caption 6. It is chiefly the mother's responsibility to raise the baby since the father does not spend very much time with the family. Like in this picture, babies hang on to their mothers by gripping their hair. By the time they are two years old, they can swing from branch-to-branch by themselves. The government of Africa has made a large park (game reserve) to protect chimpanzees from becoming extinct (the dying out of a certain species).

Caption 7. Chimps do not like loud noises. They get very excited and nervous during a thunderstorm. The males perform a strange rain dance. As they run down a hill, they wave and drag branches, slap the ground, and hit tree trunks. The males will climb back up to the top of the hill and run down many times. The females and young children sit on branches and scream during the lightning and thunder. The rain dance may last as long as 30 minutes.

Caption 8. Chimpanzees are one of the smartest animals on earth. They have brains that are similar to humans but they do not have the ability to speak. Since the chimp resembles man in many ways, scientists have studied their behavior in many experiments. This chimp sits in a relaxed position. He is about 4½ feet in height and weighs about 130 pounds. His average life span will be about 45 years. He is strong enough to snap a thick branch in one hand.

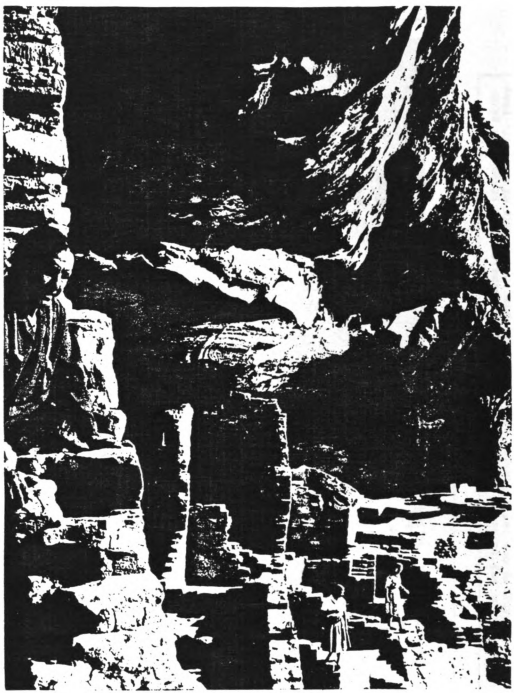


Caption 9. Chimps like to spend many hours a day cleaning (grooming) each other. This grooming is an important part of their social life. This process of co-operative group living is called socialization (a process by which humans or animals learn to meet the common needs of the social group). The group of chimps in this picture is picking the seeds, dirt, and ticks out of each other's hair. This behavior seems to show the affection they have for each other.

Caption 10. Chimps show their feelings by hugging each other, holding hands, patting each other on the back, and kissing. They especially like to hug each other when they are nervous. The lady on the left lived with chimps for many months before they would touch her. She observed them very carefully and recorded their behavior. She is a famous zoologist (a scientist who studies the physical features, the social behavior, and the natural habitat of animals).

Caption 11. In the late afternoon, each chimp makes a sleeping nest in the fork branches of a tree. It takes only a few minutes to bend and interweave the branches into a nest. He holds the branches with his feet and puts leafy twigs under him for a pillow. This nest will protect him from the wet forest floor. This ability to construct nests shows that chimps can adapt (change their behavior to adjust to the environment) to forest living.

Caption 12. Wild chimps have learned how to make very simple tools for catching food. They take twigs and grass stems and poke them into termite mounds. The termites cling to the stems when they are withdrawn. The chimps like the taste of the termites. When the stem becomes bent, the chimp breaks it off. This behavior shows that chimps are smart enough to make tools out of natural objects, such as plant stems. Young chimps learn this behavior by watching and imitating their parents. Very few animals make their own tools. Later, caveman made more skillful tools, especially hunting weapons. A tool is a hand held instrument designed to perform a useful job.

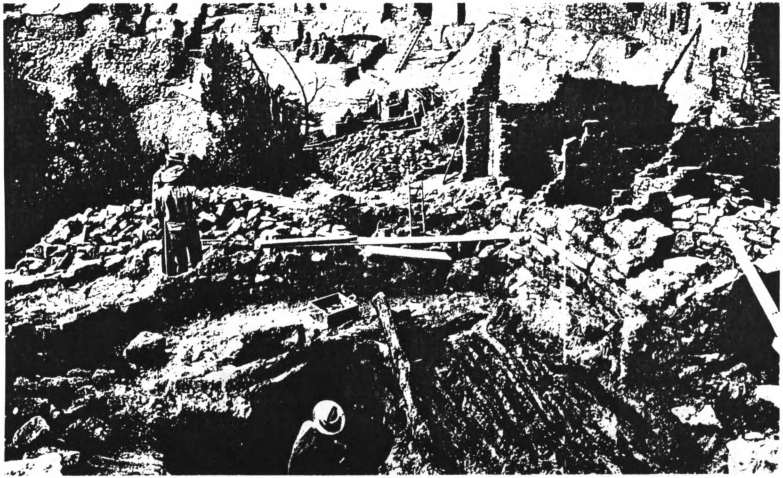


Caption 1. This large cave village is located on the side of a steep cliff with a plateau above and a valley below. Prehistoric (the time before man made written records) Indians of early America built these villages about 700 years ago. These sandstone cliffs are located in the State of Colorado in the Western United States. Tourists visit these caves in Mesa Verde National Park. The ceiling stripes were made by mineral deposits from rainwater.

Caption 2. Cliff Indians had to climb above their caves to hunt animals, grow crops, and gather water. In the painting on the left, hunters have trapped a deer on the edge of a cliff. They will try to kill the deer with rocks and wooden arrows with stone points. The hunters are wearing yucca plant scandals and deer skin shirts. On the right, you can see the small footholes for climbing the cliff. The women will fill their clay pots in rainwater holes. These early Indians dug long irrigation ditches for growing food and built storage tanks for drinking water.

Caption 3. This round room was called a kiva. It was very important because it was used as a workshop and religious room. Each cliff village had many kivas and each one was shared by several families. Sometimes, these rooms were filled with dirt to bury dead persons. Cliff villagers believed in a life after death. They buried tools and pots of food for the spirit of the dead body. This scientist is looking into a vent which provided a flow of fresh air from outside the kiva. The hole in the center of the room was used as a fireplace.

Caption 4. This Indian family is working inside a kiva which does not have a door. The woman on the ladder is entering this round room through a hole in the ceiling. She is holding a basket of corn while a man is spinning cotton next to a weaving loom. The yucca cords on the loom will be made into a blanket. The other man is chipping an arrowhead. The floor has a hole leading to the spirit world. The smoke keeps out evil spirits.



Caption 5. The scientists in this picture are digging and searching for old rooms, bones, pottery, tools, and other objects. They will examine these objects carefully because the Cave Indians did not leave a written language. Scientists who study the life and culture of early peoples are called archaeologists. They can determine the age of this village by counting the growth rings in the old logs. By studying human skeletons, they have learned that early Indians had poor teeth, bone diseases, lived about forty years, and were smaller than modern man.

Caption 6. Members of this cliff village are cooking their evening meal of corn broth while a hunter enters the cave carrying a deer. The skin will be used for clothing, the bones will provide tools, and the sinews will become bowstrings and thread. These Indians probably lived in caves for protection from their enemies. Later, they moved out of these cliffs because the weather became too hot and there was a shortage of food and water.

Caption 7. Before these Indians moved into caves, they lived on the flat plains in stone-and-adobe houses. Later, they designed these pueblos (flat-roofed, adobe homes built on top of each other, as in this picture). They used ladders instead of doors and steps. The ladders could be pulled up in case of an enemy attack. On the left, two men are repairing a wall made of clay and rock. At the tower, other men are lifting building materials on a rope.

Caption 8. A modern artist painted this picture based on information gathered by scientists. Scientists excavate (or uncover by digging) old settlements to discover valuable objects made by early man. In this picture, the Indians are spreading ears of corn on rooftops. They are cutting the squash in rings and hanging it on sticks to dry. It will be necessary to store this food for the winter. The food is grown on the plateau above the cave.

Caption 9. Women did the cooking and made the pottery. This modern Indian woman is showing you how the Cave Indians made bread and pottery. On the left, she is peeling thin bread from her fireplace griddle. She folds it like a newspaper. It is made from corn meal baked for a few seconds on a smoking hot griddle. On the right, she is painting a clay pot which she shaped with her hands. After she paints the design, she will bake it over an open fire to make the clay hard. She will carry it on her head with a soft cushion under the pot.

Caption 10. Scientists have discovered many fragments of pottery and glued them together. The Cliff Indians made many drinking mugs, pitchers, cooking pots, and bowls. Pottery was often painted with black designs on white backgrounds. Indians added sand and crushed rocks to the clay to make it strong. Old objects made by human hands are called artifacts; such as tools, pottery, clothing, etc. These artifacts help us to learn more about ancient cultures.

Caption 11. The families in a cave village were interdependent (they depended on each other for help). About 400 Indians lived together in a large cave village. Here a mother is covering a bowl with a layer of white clay while her daughter is mixing the clay with water. In the background, the grandmother is baking the finished bowls while her grandson gathers firewood. Large jars were used for storing water during the long and dry summer.

Caption 12. Handicrafts were important to the Cave Indians. Handicrafts include artistic objects which require practice and skillful use of the hands. These modern Indians are making handicrafts using methods very similar to their ancestors. The man on the left is making a coiled basket from a sumac plant. He will use vegetable stains to color the basket. It will take about two weeks to complete it. The man on the right is making a belt. First, he stretches and separates the colors of thread around five pegs. Later, he will weave the threads together on a loom. Red hot chilis hang from the ceiling to dry. The moccasins (shoes) are hung to protect them from mice.

Name _____

QUESTIONS ON THE LIVING HABITS OF WILD CHIMPANZEES

Directions: First, it is very important for you to read all 12 captions carefully before you complete the sentences below.

Part A: Locating and Completing Information

1. Since they (chimps) travel long distances in search of food, we say they are _____ hunters. (The answer is in Caption 2.)

   marathon nomadic energetic

2. Small chimps sleep with their mothers until they are about _____ _____. (The answer is in Caption 4.)

   six months old one year old three years old

3. Since chimps usually eat _____, we say they are mostly herbivorous (hûr biv'ər əs). (The answer is in Caption 5.)

   plants meat

4. By the time they are _____, they (chimps) can swing from branch-to-branch. (The answer is in Caption 6.)

   one year old two years old four years old

5. A chimp's life span will be about _____. (The answer is in Caption 8.)

   20 years 45 years 65 years

6. The process of _____ group living is called socialization (sō'shəl i zā'shən). (The answer is in Caption 9.)

   independent co-operative

7. It takes only a few minutes to _____ the branches into a nest. (The answer is in Caption 11.)

   bend and interweave tie and connect

8. Chimps are smart enough to make tools out of natural objects, such as _____. (The answer is in Caption 12.)

   tree branches plant stems

Part B: Comparing Pictures and Choosing Titles

Directions: Choose the best title to describe each set of pictures. Try to decide what all three pictures have in common. Then draw a circle around the letter for the best title.

9. Look carefully at the pictures above captions 1, 3, and 7.

   a. Chimps Holding Bananas

   b. Chimps Walking and Standing

   c. Chimps Running Downhill

10. Look carefully at the pictures above captions 2, 6, and 11.

   a. Using Tree Branches

   b. Following Each Other

   c. Hanging From Branches

11. Look carefully at the pictures above captions 4, 9, and 10.

   a. Taking Care of Children

   b. Cleaning Each Other

   c. Touching Each Other

12. Look carefully at the pictures above captions 5, 8, and 12.

   a. Chimps Eating Bananas

   b. Chimps Using Their Hands

   c. Resting Arm on Knee

Part C: Creative Thinking Skills

Directions: Write complete sentences for your answers to the problems below. If you need more space, use the back of the paper.

13. In the picture above caption 8, you can see that a chimp's big toe is split apart from his other toes (the same is true of his thumb). Think of two reasons why this special feature is useful to chimps.

_____

_____

14. Although chimps cannot speak or write like humans, we know they are very intelligent. Describe two simple experiments you could try to test a chimp's intelligence.

_____

_____

15. Think of two reasons why chimps would probably prefer living in a park instead of a zoo. Why do you think this lady scientist chose to study chimps in a national park instead of a zoo? Explain.

_____

_____

16. Pretend that you want to make friends with some wild chimps, but you find they are afraid of you. If you could teach them some skills, they would probably admire you. Describe two skills you will teach the chimps (consider their physical features and personalities).

_____

_____

Name _____

QUESTIONS ON THE LIVING HABITS OF WILD CHIMPANZEES

Part A: Locating Pictures and Completing Information

1. Read each caption carefully and decide which picture goes above it. After you place all 12 pictures above their captions, ask the teacher for the Answer Key to find out if the pictures are in their correct positions. Leave the pictures on the board until you have finished answering all of the questions.

2. Small chimps sleep with their mothers until they are about _____ _____. (The answer is in Caption 4.)

   six months old one year old three years old

3. Since chimps usually eat _____, we say they are mostly herbivorous (hûr biv'er əs). (The answer is in Caption 5.)

   plants meat

4. By the time they are _____, they (chimps) can swing from branch-to-branch. (The answer is in Caption 6.)

   one year old two years old four years old

5. A chimp's life span will be about _____. (The answer is in Caption 8.)

   20 years 45 years 65 years

6. The process of _____ group living is called socialization (sō'shəl i zā'shən). (The answer is in Caption 9.)

   independent co-operative

7. It takes only a few minutes to _____ the branches into a nest. (The answer is in Caption 11.)

   bend and interweave tie and connect

8. Chimps are smart enough to make tools out of natural objects, such as _____. (The answer is in Caption 12.)

   tree branches plant stems

9. Since they (chimps) travel long distances in search of food, we say they are _____ hunters. (The answer is in Caption 2.)

marathon nomadic energetic

Part B: Comparing Pictures and Choosing Titles

Directions: Choose the best title to describe each set of pictures. Try to decide what all three pictures have in common. Then draw a circle around the letter for the best title.

10. Look carefully at the pictures above captions 1, 3, and 7.

a. Chimps Holding Bananas

b. Chimps Walking and Standing

c. Chimps Running Downhill

11. Look carefully at the pictures above captions 2, 6, and 11.

a. Using Tree Branches

b. Following Each Other

c. Hanging From Branches

12. Look carefully at the pictures above captions 4, 9, and 10.

a. Taking Care of Children

b. Cleaning Each Other

c. Touching Each Other

13. Look carefully at the pictures above captions 5, 8, and 12.

a. Chimps Eating Bananas

b. Chimps Using Their Hands

c. Resting Arm on Knee

Part C: Creative Thinking Skills

Directions: Write complete sentences for your answers to the problems below. If you need more space, use the back of the paper.

14. In the picture above caption 8, you can see that a chimp's big toe is split apart from his other toes (the same is true of his thumb). Think of two reasons why this special feature is useful to chimps.

_____

_____

15. Although chimps cannot speak or write like humans, we know they are very intelligent. Describe two simple experiments you could try to test a chimp's intelligence.

_____

_____

16. Think of two reasons why chimps would probably prefer living in a park instead of a zoo. Why do you think this lady scientist chose to study chimps in a national park instead of a zoo? Explain.

_____

_____

Name _____

ANSWER SHEET FOR THE LIVING HABITS OF WILD CHIMPANZEES

Directions: First, read the lesson carefully before you answer the questions at the end of the booklet. Write your answers on this paper.

Part A: Locating and Completing Information

1. _____

marathon nomadic energetic

2. _____

six months old one year old three years old

3. _____

one year old two years old four years old

4. _____

plants meat

5. _____

independent co-operative

6. _____

20 years 45 years 65 years

7. _____

tree branches plant stems

8. _____

bend and interweave tie and connect

Part B: Comparing Pictures and Choosing Titles

Directions: Choose the best title to describe each set of pictures. Try to decide what all three pictures have in common. Then draw a circle around the letter for the best title.

9. Look carefully at the pictures above captions 1, 3, and 7.

   a. Chimps Holding Bananas

   b. Chimps Walking and Standing

   c. Chimps Running Downhill

10. Look carefully at the pictures above captions 2, 6, and 11.

   a. Using Tree Branches

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11. Look carefully at the pictures above captions 4, 9, and 10.

   a. Taking Care of Children

   b. Cleaning Each Other

   c. Touching Each Other

12. Look carefully at the pictures above captions 5, 8, and 12.

   a. Chimps Eating Bananas

   b. Chimps Using Their Hands

   c. Resting Arm on Knee

Part C: Creative Thinking Skills

Directions: Write complete sentences for your answers. If you need more space, use the back of the paper.

13. _____

_____

_____

14. _____

_____

_____

15. _____

_____

_____

16. _____

_____

_____

Name _____

QUESTIONS ON CLIFF VILLAGE INDIANS OF EARLY AMERICA

Directions: First, it is very important for you to read all 12 captions carefully before you complete the sentences below.

Part A: Locating and Completing Information

1. Prehistoric means the time before man _____.
(The answer is in Caption 1.)

lived on the earth made written records

2. Each cliff village had many kivas and each one was shared by _____
_____. (The answer is in Caption 3.)

a single family two families several families

3. The (kiva) floor has a hole leading to _____.
(The answer is in Caption 4.)

the spirit world another room

4. Scientists who study the life and culture of _____ are called archaeologists (ar'kē ol'ə jists).
(The answer is in Caption 5.)

prehistoric Indians early peoples

5. Pueblos were flat-roofed villages built _____.
(The answer is in Caption 7.)

inside large caves on top of each other

6. Scientists excavate (eks'kə vāt') old settlements to _____
_____. (The answer is in Caption 8.)

rebuild them discover objects clean them up

7. The bread was made from corn meal and baked _____
_____. (The answer is in Caption 9.)

on a hot griddle over a pit inside a clay oven

8. Artifacts (ar'tə fakts') help us to learn more about _____
_____. (The answer is in Caption 10.)

early (ancient) cultures modern cultures

Part B: Comparing Pictures and Choosing Titles

Directions: Choose the best title to describe each set of pictures. Try to decide what all three pictures have in common. Then draw a circle around the letter for the best title.

9. Look carefully at the pictures above captions 1, 3, and 5.

   a. Stripes on Cave Ceiling

   b. Walls of Bricks and Stones

   c. Shelves Inside Kiva

10. Look carefully at the pictures above captions 2, 7, and 8.

   a. Hunters in the Snow

   b. Climbing Trails and Footholes

   c. Cave Indians at Work

11. Look carefully at the pictures above captions 4, 6, and 11.

   a. Hunter Carrying Deer

   b. Members Help Each Other

   c. Ladder in Middle of Room

12. Look carefully at the pictures above captions 9, 10, and 12.

   a. Bowls and Handicrafts

   b. Legs Wrapped in Cloth

   c. Scientists Examining Pottery

Part C: Creative Thinking Skills

Directions: Write complete sentences for your answers to the problems below. If you need more space, use the back of the paper.

13. Six of the pictures on this board are paintings and not photographs. Give the six caption numbers for these paintings. Why don't we have photographs of these Cave Indians?

_____

_____

14. Pretend that you are the leader of a tribe of Cave Indians. You know that it is dangerous and takes too long to carry food and water to the cave each day. Describe two ways you might solve this problem.

_____

_____

15. Pretend that you are visiting these old caves with a friend. Your friend thinks these caves would be a great place to live. Think of three reasons why these caves could have been a dangerous place to live.

_____

_____

16. Pretend that you can go back in time and live with some Cave Indian children about your age. Describe two helpful things you could teach them and two things they could teach you.

_____

_____

_____

Name _____

QUESTIONS ON CLIFF VILLAGE INDIANS OF EARLY AMERICA

Part A: Locating Pictures and Completing Information

1. Read each caption carefully and decide which picture goes above it. After you place all 12 pictures above their captions, ask the teacher for the Answer Key to find out if the pictures are in their correct positions. Leave the pictures on the board until you have finished answering all of the questions.

2. Each cliff village had many kivas and each one was shared by _____ _____. (The answer is in Caption 3.)

   a single family two families several families

3. The (kiva) floor has a hole leading to _____. (The answer is in Caption 4.)

   the spirit world another room

4. Scientists who study the life and culture of _____ are called archaeologists (ar'kē ol'ə jists). (The answer is in Caption 5.)

   prehistoric Indians early peoples

5. Pueblos were flat-roofed villages built _____. (The answer is in Caption 7.)

   inside large caves on top of each other

6. Scientists excavate (eks'kə vāt') old settlements to _____ _____. (The answer is in Caption 8.)

   rebuild them discover objects clean them up

7. The bread was made from corn meal and baked _____ _____. (The answer is in Caption 9.)

   on a hot griddle over a pit inside a clay oven

8. Artifacts (ar'tə fakts') help us to learn more about _____ _____. (The answer is in Caption 10.)

   early (ancient) cultures modern cultures

9. Prehistoric means the time before man _____.
(The answer is in Caption 1.)

lived on the earth made written records

Part B: Comparing Pictures and Choosing Titles

Directions: Choose the best title to describe each set of pictures. Try to decide what all three pictures have in common. Then draw a circle around the letter for the best title.

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_____

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_____

_____

16. Pretend that you are visiting these old caves with a friend. Your friend thinks these caves would be a great place to live. Think of three reasons why these caves could have been a dangerous place to live.

_____

_____

_____

Name _____

ANSWER SHEET FOR CLIFF VILLAGE INDIANS OF EARLY AMERICA

Directions: First, read the lesson carefully before you answer the questions at the end of the booklet. Write your answers on this paper.

Part A: Locating and Completing Information

1. _____

lived on the earth made written records

2. _____

a single family two families several families

3. _____

the spirit world another room

4. _____

prehistoric Indians early peoples

5. _____

inside large caves on top of each other

6. _____

rebuild them discover objects clean them up

7. _____

on a hot griddle over a pit inside a clay oven

8. _____

early (ancient) cultures modern cultures

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Directions: Choose the best title to describe each set of pictures. Try to decide what all three pictures have in common. Then draw a circle around the letter for the best title.

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   a. Bowls and Handicrafts

   b. Legs Wrapped in Cloth

   c. Scientists Examining Pottery

Part C: Creative Thinking Skills

Directions: Write complete sentences for your answers. If you need more space, use the back of the paper.

13. _____

_____

_____

14. _____

_____

_____

15. _____

_____

_____

16. _____

_____

_____

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