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VISUAL APTITUDE AS IT RELATES TO STUDENT

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CHAPTER I

INTRODUCTION

Background for the Study

Perception has been defined as an information-handling process and has long been recognized as a fundamental phenomenon of psychological functioning. Some educators have sought to develop approaches to the teaching-learning process based upon perceptual characteristics. Psychologists and art educators in particular have focused on characteristic ways individuals are inclined to perceive themselves and their environment, and have as a result, identified "perceptual types".

Viktor Lowenfeld (1939 and 1945) has demonstrated existence of a typological classification for individuals who vary with respect to their psychological orientation towards sensory perception or perceptual aptitude. His "visual-haptic" typology classifies people into a range from those who are inclined toward vision and visual imagery to those who are inclined toward non-visual sensory experience and kinaestheic or tactile imagery. Lowenfeld's research (1939 and 1945) indicates that only half of the general population can fully benefit from visual stimuli. "The others are not really reached or may even become frustrated by this type of stimulation. Each type should be stimulated in the direction of their experiences and thinking." (Lowenfeld, 1952. p. 232)

Many educators believe that their students are different from their counterparts of twenty or more years ago. This is held to be true at all levels of education, pre-school through college. Is today's student different? If so, how is he different? Students who are presently in school may be assumed to be more visual, better informed and intellectually skilled, because they have been exposed to television from birth. Although television is considered to be the primary cause, these same students have been exposed to many other kinds of visual and audiovisual communications: pictures and publications, cartoons, films, slides, visual catalogues, etc. As a consequence students come to school with a new language--a visual language.

Recent developments in the area of visual literacy indicate that visual experiences do in fact contribute to the total development of the child. However, the research in this area has been concerned with the effect of visual literacy programs rather than with the differences that may exist between children and, more importantly, what significance, if any, these differences have for school learning. There is a need for a greater understanding of visual differences that exist between children and what affect these differences have on their achievement in school. Consequently, this research was designed to study one aspect of visual aptitude to determine if it has any affect on the child's success in school.

Statement of the Problem

The problem of this study was: How does visual aptitude tend to relate to achievement in reading and mathematics?

Purpose of the Study

In The Nature of Creativity and Creative and Mental Growth, Lowenfeld emphasizes the implications that student differences in visual-haptic aptitude have for art education, but he also indicates that the visual-haptic aptitude dimension of individual differences has far reaching significance in other fields as well. Lowenfeld's work in the area of visual-haptic aptitude provides a means of identifying students with different visual orientations to their environment. Using Lowenfeld's theory of visual -haptic aptitude as a base, it is the purpose of this study to take an initial step toward providing information as to how individual differences in this aptitude dimension may affect school learning in the areas of reading and mathematics. This study investigated the relationship between visual aptitude, as measured by Successive Perception I, and achievement in reading and mathematics, as measured by standardized achievement tests. In addition, it was the purpose of this study to determine if visual aptitude had any affect on student achievement gain in these curriculum areas.

Statement of Hypotheses

The following assumptions are made relative to the relationship between visual aptitude and student achievement in reading and mathematics prior to the statement of the hypotheses.

1. Students who are highly "visual", as measured by Successive Perception I Test, will have higher achievement in reading, as measured by standardized achievement tests, than students who have less visual aptitude, as measured by Successive Perception I Test.

2. Students who are highly "visual", as measured by Successive Perception I Test, will have higher achievement in mathematics, as measured by standardized achievement tests, than students who have less visual aptitude, as measured by Successive Perception I Test.

According to Lowenfeld (1957), as a child approaches adolescence his preference toward visual experiences (visual-haptic aptitude) crystallize. In order to examine what affect visual aptitude has on achievement as a child approaches adolescence, the following hypotheses are stated:

3. Students with high-visual aptitude, as measured by

Successive Perception I Test, will have higher reading achievement gain, as measured by standardized test scores, than students with medium-visual aptitude and low-visual aptitude, as measured by Successive Perception I Test , from grades four to seven.

4. Students with high-visual aptitude, as measured by Successive Perception I Test, will have higher mathematics achievement gain, as measured by standardized test scores, than students with medium-visual aptitude and low-visual aptitude, as measured by Successive Perception I Test, from grades four to seven.

5. Students with high-visual aptitude, as measured by Successive Perception I Test, will have higher reading achievement gain, as measured by standardized test scores, than students with medium-visual aptitude and low-visual aptitude, as measured by Successive Perception I Test, from grades seven to eleven.

6. Students with high-visual aptitude, as measured by Successive Perception I Test, will have higher mathematics achievement gain, as measured by standardized test scores, than students with medium-visual aptitude and low-visual aptitude, as measured by Successive Perception I Test, from grades seven to eleven.

In order to statistically test the relationship between visual aptitude and student achievement in reading and mathematics, the following null hypotheses were used:

1. There is no significant correlation between the student's

visual aptitude, as measured by Successive Perception I Test, and reading achievement, as measured by standardized achievement tests.

2. There is no significant correlation between the student's visual aptitude, as measured by Successive Perception I Test, and mathematics achievement, as measured by standardized achievement tests.

3. There is no significant difference in reading achievement gain, as measured by standardized test scores, from grades four to seven between high-visual aptitude, medium-visual aptitude and low-visual aptitude students, as measured by Successive Perception I Test.

4. There is no significant difference in mathematics achievement gain, as measured by standardized test scores, from grades four to seven between high-visual aptitude, medium-visual aptitude and low -visual aptitude students, as measured by Successive Perception I Test.

5. There is no significant difference in reading achievement gain, as measured by standardized test scores, from grades seven to eleven between high-visual aptitude, medium-visual aptitude and low-visual aptitude students, as measured by Successive Perception I Test.

6. There is no significant difference in mathematics achievement

gain, as measured by standardized test scores, from grades seven to eleven between high-visual aptitude, medium-visual aptitude and low-visual aptitude students, as measured by Successive Perception I Test.

Limitations of the Study

Like most efforts in behavioral science research, some phases of the design and analysis in this investigation were a direct result of compromises with what one might consider to be ideal conditions. Such yielding was kept at a minimum and done grudgingly. However, it is recognized that if any research were to be conducted in this area, it would, at least in the initial stages, probably have to be conducted with certain limitations. These limitations are provided here to provide an objective basis upon which to evaluate this research study and to aid future investigators who chose to research this area.

The population of this study was limited to the eleventh grade students at Norman High School, Norman, Oklahoma. Any generalizations beyond this population will be valid only to the extent that the population sampled is representative of some other population.

This study was purposely limited to visual aptitude as it relates to reading and mathematics achievement. This by no means exhausts all the possible aptitudes that might have an affect on student achievement in these areas. Nor does it exhaust all the school learning areas that are affected by visual aptitude. Therefore, the results will provide information only about visual aptitude as it relates to student achievement in reading and mathematics.

Student achievement was measured by test scores on standardized achievement tests. California Achievement Test (CAT) and Sequential Test of Educational Progress (STEP). The results will provide only information about achievement on such tests as they relate to school learning.

Visual aptitude was limited to the ability to integrate and form comprehensible wholes from partial impressions, as measured by Successive Perception I Test (SPT-I). The validity and reliability of the measuring instrument posed still another limitation (see Selection of the Instrument, p.33). However, since this was an initial investigation in this area the SPT-I was chosen because it appeared to be a highly refined version of Lowenfeld's Test of Integration of Successive Impressions.

Definition of Terms

Haptic - term given to the perceptual type inclined to use body self, muscular sensations, kinaesthetic experiences, and touch impressions as intermediary to his experiences, rather than merely his sense of vision, as measured by Lowenfeld's test battery of visual-haptic aptitude. Opposite of visual.

Indeterminate - term given to the perceptual type who possesses equal or nearly equal amounts of visual and haptic predispositions, as measured by Lowenfeld's test battery of visual -haptic aptitude.

Perceptual type - term used to categorize individuals with similar perceptual characteristics.

Visual - term given to the perceptual type who uses the sense of vision as intermediary to his experiences, as measured by Lowenfeld's test battery of visual-haptic aptitude.

Visual aptitude - term used to describe the ability to integrate and form comprehensible wholes from partial impressions, as measured by Successive Perception I Test.

Visual-haptic aptitude - term used by Lowenfeld to describe his typology classification of people into a range from visual imagery to kinaesthetic or tactile imagery.

Significance of the Study

Educators are being challenged to create visual learning materials for use in the learning process. This study of visual aptitude as it relates to student achievement was an effort to provide empirical data on the visual aptitude of students and how this aptitude affects their achievement in certain school subjects (reading and mathematics). Ultimately, such data may be applied to designing instruction in these school subject areas to meet or accomodate varieties in learning or perceptual styles.

CHAPTER II

A REVIEW OF SELECTED LITERATURE

This study is concerned with the visual aspect of Lowenfeld's theory of visual-haptic aptitude. Lowenfeld's work, along with related research provides a need for the educator to be concerned with visual differences among children. The literature reviewed here represents that which is deemed important to provide the background for this study of visual aptitude.

This review is grouped into three sections. The first section includes Lowenfeld's theory of visual-haptic aptitude and related research. The second section reviews research that investigates the nature of visual aptitude in fields other than art. The third section contains literature and research in the area of visual literacy that relates to the present investigation.

Selected Research Related to Visual-Haptic Aptitude

Lowenfeld's theory of visual-haptic modes grew out of research on the art work of children in Austria and the United States. It was during his many years of work with blind children that the differences in expressive styles became apparent. Through his observations

Lowenfeld discovered that some people, regardless of whether they were normally sighted or blind, are inclined to graphically express themselves in fundamentally different ways. By closer study and analysis, Lowenfeld identified two perceptual types, "visuals" and "haptics". (Lowenfeld, 1939)

"Visual" individuals are those who tend to prefer optical experiences over all other types of sensory experiences (i.e., tactile, kinaesthetic, etc.). The visually oriented individual has a tendency to transform kinaesthetic and tactile experience into visual images; he is almost entirely lost in the dark and depends mostly on his visual awareness of the outside world. "He reacts as an observer, as a spectator, who sees first the whole and then the details, and then synthesizes the total impressions into a new whole. The visual person observes the complex and everchanging appearances of shapes and forms." (Lowenfeld and Brittain, 1969, p. 261)

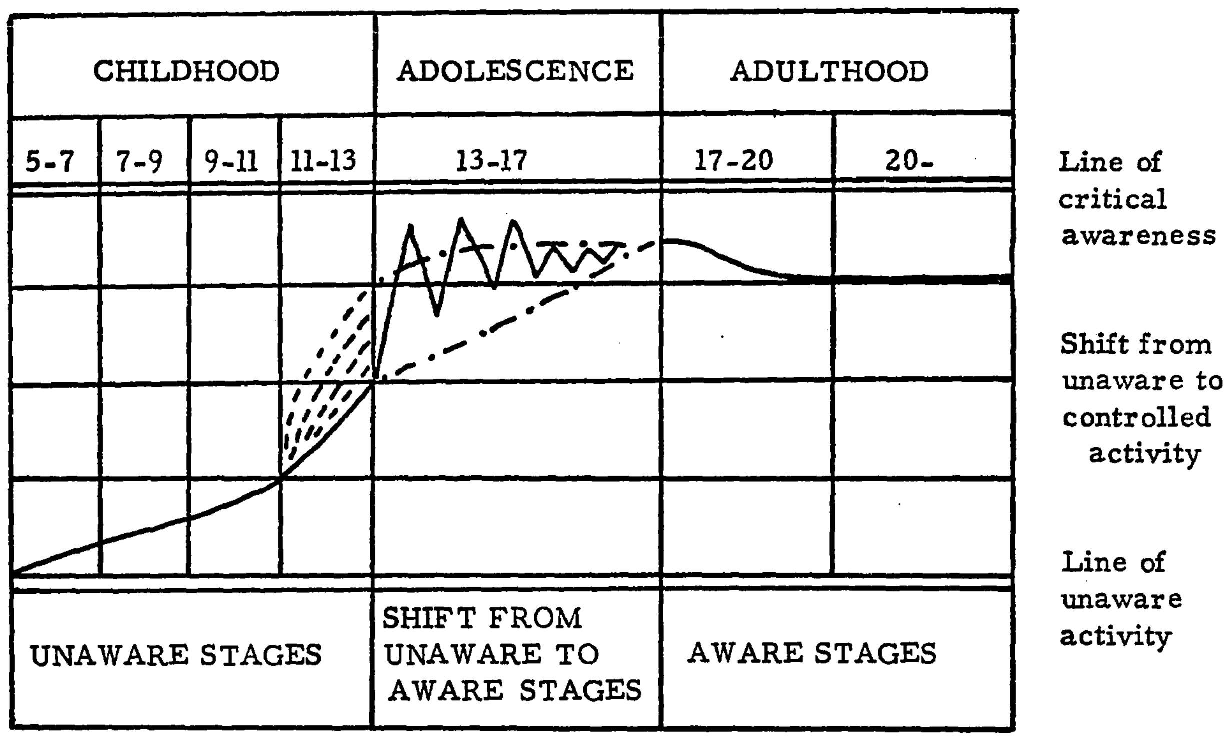
"Haptic" individuals are people who use their body-self, muscular sensations, kinaesthetic experiences, touch impressions, and all other experiences to place value upon the self as it relates to the enviornment. It should be pointed out that haptics and visuals do not differ in their ability to "see". For the haptic, kinaesthetic and tactile experiences are not transformed into visual ones, but he does give meaning to and is content with just bodily sensation itself; his creative expression of visual data is subjective. (Lowenfeld, 1957)

Between the "visuals" and "haptics", Lowenfeld identified individuals who possess equal or nearly equal amounts of both visual and non-visual predispositions. These individuals may possess a slight tendency toward one of the two extremes but it cannot be identified. Individuals who fit in this central position are classified as "indeterminates".

Lowenfeld (1957) reports that as a child approaches adolescence his preference toward visual experiences (visual-haptic aptitude) crystallize. A visually minded person would be discouraged if he were stimulated with subjective experiences, emotional qualities, or body experiences; likewise, a haptic or subjective minded person would be inhibited if he were stimulated by mere visual experiences. Figure 1. shows the development of a person's reaction to visual information from childhood to adulthood.

In his research on perceptual tests to discriminate between visual and haptic types (Appendix A) Lowenfeld (1945) reports that approximately 47% of all those tested were visually inclined, 23% were haptically oriented, and roughly 30% were classified as indeterminates. Thus it would appear that one among four individuals depends upon touch and kinaesthetic rather than upon vision. Most people (seventy-five percent) have an appreciable tendency toward one extreme or the other. Lowenfeld further explained that "the tendency toward these two antipodes of experience is important not only for stimulation in creative activity, but also to life in general (especially to the proper choice of occupation...)." (Lowenfeld and Brittain, 1969, p. 259)

Figure 1. Development of Preference toward Visual Experiences



- - - - - Meaning of good art stimulation during period of "reasoning".

———— Normal curve without good stimulation stops far below the "line of controlled activity" thus creating a gap of indecision.

Characterization of fluctuation between childlike awareness and controlled activity of adults.

—.—.—. Smooth curve of the "genius" who gradually move into the stages of "critical awareness", usually at a much earlier age.

(Lowenfeld, 1957, p.233)

Lowenfeld (1939, p. 82) says one should use the term "visual perception" when impression coming from the other senses are subordinate to those coming from the eye and visual impressions are the dominant features in a percept. Haptic perception, as defined by Lowenfeld (1939, p. 82) is the synthesis between the external non-optical sensory impressions and the intimate subjective experiences of the self.

Vernon (1937, pp. 190-91) described the existence of different categories of persons or perceptual types from studies of perceptual attitude frequently adopted by different individuals.

> The oldest and perhaps best known of the categories of perceptual types are the subjective and objective... The objective type was said to be characterized by rigid occular fixation, narrow perceptual span and objective accuracy; also by perception of words by their dominating letters..... The subjective type was characterized by a fluctuating fixation, broad perceptual span, and subjective interpretive tendencies (lack of accuracy); and by the perception of words from their total word form.

In a later work, Vernon (1952) noted the decline of describing differences in mode of perceiving. She does mention one classification system that had been advanced comparatively recently; Lowenfeld's visual-haptic typology.

> These types (visual and haptic) characterize those individuals, mainly children, who perceive much more easily by vision, and those who perceive relatively well by touch and kinaesthesis. Many blind children rather naturally fall into the later class. But the main difference between these two types lies in their ability to use visual, or kinaesthetic and tactile imagery. Thus this typology resurrects the

> earlier very popular subject of differing imaginal types, for the existence of which there is much evidence. There seems to be little doubt that certain individuals imagery of modality is relatively clearer and more vivid than imagery of other modalities. But no one except Lowenfeld seems to have followed up the relationship of the preferred imagery of perceiving. (Vernon, 1952, p. 252)

Vernon's remarks with respect to the lack of interest in working with typological types in general and with visual-haptic in particular, seem to be quite apropos. Lowenfeld's work is held in high esteem by art educators, yet his hypothesis concerning existence of a visual-haptic continuum has seemingly been of little interest to professional researchers in psychology. However, recent developments in the area of visual literacy have revived this area as a research topic.

Nowhere in his writings did Lowenfeld present evidence of reliability or validity of his test, however, he has continued to have strong influence upon art educators. As far as this writer can determine, few have doubted or negated the "theory" of visual-haptic perceptual types. What criticism that has been directed at his conclusions and assumptions are based on inappropriate and incomplete research methodologies. Rouse (1963) attributed the widespread acceptance of Lowenfeld's work to the almost complete lack of sophistication in statistical research techniques among art educators at the time.

It was not until 1951 that an attempt was made to replicate part of Lowenfeld's results. Wiggins (1951) replicated the "Test of

Integration of Successive Impression" and the "Word Association Test" to determine their validity. He found the correlation between these tests to be .57. However, information was not provided concerning the reliability of each test separately.

Flick (1962) developed Ten Tests of the Visual-Haptic Aptitude. He determined that in relation to the tactile tests, sight played a dominant role in recognition for the visually-minded subjects. Flick reported that visually-minded subjects did poorly when expected to identify similarities of shape through the tactile sense only; they did better when permitted to look at a set of shapes and, by feeling, match them with an identical set in a container beside them. His findings showed that Lowenfeld's Test of Tactile Impressions did not measure true haptic responses.

Read (1945), Goodenough, (1926) and Jung (1923) have each described perceptual and personality characteristics which closely resemble those of Lowenfeld's visual-haptic traits. Murphy (1954) suggested there is an indication of more visual-mindedness in women, while men tend to be more haptically-minded and conscious of their bodies, bodily sensations and kinaesthesia.

A limited amount of research concerned with the electrical activity of the human brain seems to be related to visual aptitude. The brain waves that seem to be related to this aptitude are the alpha rhythms. When recorded on an electroencephalograph (EEG) chart, these rhythms are found in the frequency band between eight and thirteen cycles persecond.

Walter (1953) in an EEG study reported that individuals with persistent alpha rhythms which are hard to block with mental efforts, tend to auditory, kinaesthetic, or tactile perception rather than visual imagery. From the results of tests administered to 600 individuals, Walter distinguished between a "visualizer" (the M type) "with few if any alpha rhythms," a "non-visual" (the P type) "with persistent alpha activity" and a "mixed-type" (the R type) "with a responsive alpha rhythm."

Lowenfeld (1957, pp. 262-63) reported Walter's findings to support his hypothesis of visual-haptic aptitude. The results of Lowenfeld's investigation indicated that approximately half of the individuals reacted visually, whereas not quite a fourth reacted haptically. According to Lowenfeld these figures completely coincide with those of Walter in his entirely independent study.

Drews (1958) reported a study which showed the relationships between electroencephalographic imagery variables and perceptual-cognitive process. Drews hypothesized that visual imagery dominance in an individual's perceptual make-up would greatly influence the efficiency to solve certain mental tasks. Using college-age students he recorded EEG's from the occipital lobes while the subjects underwent the following two tasks: Task A consisted of the subject opening and closing their eyes for periods of two minutes each, while EEG recordings were made of the subject responses to light; Task B consisted of an EEG recording of alpha response to the subjects attempt at mentally visualizing and manipulating geometric figures to form various combinations on a table top. From these recordings, Drews categorized the subjects into three types: the visualizers; the non-visualizers; and the responsives. His results showed that there tended to be approximately 25% who had a natural inclination to respond in visual ways; 25% responded in non-visual ways; 50% possessed both characteristics. Although these percentages do not identically conform to Lowenfeld's figures (47% visual; 23% haptic; 30% indeterminate), they do lend strong support to the notion that a relationship does exist between perceptual types and EEG. They also support the premise that visual-haptic types may be linked to inborn psysiological sources as Lowenfeld maintained.

Visual-Haptic Research Related to Fields Other than Art

There has been a limited amount of research in the relationship of visual-haptic aptitude as it relates to fields other than art. Lowenfeld (1939) indicates that visual-haptic aptitude can become an important means for helping young people in selecting life occupations that fit other, and more general psychological variables. The notion of visual-haptic aptitude differences...

> seemed to be also of some significance in regard to proper choices of occupations. There are occupations in which

> visual control is not only impossible but would interfere with the efficiency of the worker; mechanical jobs which done inside a case with the hands as the only control; work in darkness; work on switchboards. It is also clear that there are occupations which the main emphasis is on the use of eyes. They deal with occular observations; estimation of distance; orientation; surveying. Certainly a great number of occupations require both abilities, yet it is often possible to determine which of these aptitudes is dominate and of greater importance. (Lowenfeld, 1939, p. 226)

Erickson (1964) investigated the relationship of visual-haptic aptitude to student achievement in beginning mechanical drawing. He found that visually oriented subjects were superior to haptically inclined students in mechanical drawing, they were not necessarily superior achievers in general academic skills. In a more recent study Erickson found that "the mean level of student achievement in beginning mechanical drawing is significantly affected by and is directly related to the visual-haptic orientation of the student." (Erickson, 1966, p. 105) In this study, Erickson also examined the visual-haptic orientation of the teacher as it relates to student achievement in beginning mechanical drawing. He found that the mean level of student achievement is significantly affected by and inversely related to the visual-haptic orientation of the teacher, e. g., students with the highest mean level of achievement in beginning mechanical drawing were in the haptic oriented teacher's class.

Clark (1971) attempted to compare the cognition of students (differing in visual-haptic aptitutde) who were exposed to different learning treatments. Although Clark found no significant difference for the aptitude levels, the mean scores indicated that visual students did better then the indeterminates and haptic students.

In light of his studies, Erickson (1966) made the following suggestions for future research:

> What effect might the visual-haptic aptitude have on scholastic achievement in curriculum areas such as spelling, mathematics, and reading? It is hoped that future investigations will attempt to answer... questions relative to visual-haptic aptitude and its relation to the teaching-learning process in an attempt to advance a body of scientific knowledge that will eventually make "teaching the whole child" a reality. (Erickson, 1966, p. 108)

Erickson (1969) discussed the possibility that the continum of aptitudes defined by Lowenfeld hold significant implications for the development of reading skills.

> A cursory review of levels of reading skill development disclosed some non-visual traits that are generally associated with slow readers. Using a finger as a pointer to point out each word along a line as it is read, reading aloud to oneself, and silently mouthing each word as it is read are few examples of auditory and kinaesthetic "aids" that are often employed by low ability level readers. Such behavioral patterns would be considered non-visual or haptic in nature. Conversely, there are individuals who exhibit visually-oriented behavioral patterns in their reading. Focusing attention down the middle of the page and "reading" whole lines, sentences, or phrases, as opposed to single words, are examples of visually-oriented behavioral patterns generally recognized as being associated with high ability level readers. (Erickson, 1969, p. 257)

Erickson (1969) attempted to identify the relationship between perceptual aptitude and development of reading skills. His findings indicate that mean level of reading achievement for non-visual or haptically inclined students is likely to be from one half to one full grade level below their more visually oriented classmates at the seventh grade level.

Birch (1962) advanced the hypothesis that lack of visual and auditory over tactile-kinaesthetic sensory dominance may create conditions for concurrent propricoceptive stimuli to interfere with the visual information process during reading, which in turn may produce reading difficulties. Bakker (1967) reported that visual sensory dominance appears to be a factor significantly related to the reading ability of boys and girls with normal intelligence.

Visual Literacy Research

> The world is constituted for the child through visual perception, and shared through visual literacy activities. Certainly the learner moves from visual experiences outward into diverse realms of experience in search of meaning, but he often does so from a visual base.
>
> (Fransecky and Ferguson, 1973, p. 48)

Research seems to indicate that youngsters have astonishing visual capacities while only two months old. Debes (1968) reports that the child receives, perceives and stores up in the memory banks of the brain, sharp visual perceptions of his enviornment at a very early age. In today's world of mass media the child enters school with a visual approach to learning that is deeply ingrained. Rarely in early language learning do we capitalize on the rich and varied visual language experiences the child has had. Nor do we tap his "visual vocabulary" in building a platform for instruction.

Thompson (1973) indicates that students who are fortunate enough to come from a background where they are introduced to games, puzzles, and other visual challenges, do better in school as a rule, than students who were denied this early training. The skills required to put together a jig-saw puzzle, for example, skills involving size, shape, and placement discriminations, are exactly the same kind of skills needed to learn to read. It would follow, then, that students who begin their schooling with some degree of proficiency in visual literacy would enjoy a significant advantage over students who do not.

Fransecky and Ferguson (1973) report that researchers in the area of visual literacy have concluded that early deprivation of visual experience can and does result in serious visual problems in later life. On the other hand, they have concluded that visual enrichment in early life appears to make the learner more successful in processing the complex visual language events that are encountered in a visual culture. It is further suggested that a program of visual literacy experiences can enable compensatory or accelerated learning if effectively implemented.

Kline (1971) points out that all humans with the ability to analyze, synthesize and conceptualize are visual literate. It is only the degree to which humans can create mental images that determine their degree of visual literacy. While this is not a measure of their knowledge, it is directly related to their ability to acquire knowledge.

What is visual literacy? The National Conference on Visual Literacy defines it as follows.

> Visual literacy refers to a group of vision-competencies a human being can develop by seeing and at the same time having and integrating other sensory experiences. The development of these competencies is fundamental to normal human learning. When developed they inable a visually literate person to discriminate and interpret the visible actions, objects, and symbols natural or man-made, that he encounters in his environment. Through the creative use of these competencies, he is able to communicate with others. Through the appreciative use of these competencies, he is able to comprehendand enjoy the masterworks of visual communication.
> (Fransecky and Debes, 1972, p. 7)

This definition may satisfy the educational psychologist, but it really does not tell us what a visually literate child can do that a verbally literate child cannot do. Nor does it tell us in what ways a visually literate child's behavior is different. Fransecky and Debes (1972) state that visual behavior is analogous to verbal behavior. A child who is visually literate can "read" visual language with skill. He can compose visual statements, that is, "write" with a visual language. In addition, the visually literate child can translate from visual language to verbal and vice versa. He has a basic knowledge of the visual language and some realization that it parallels verbal language. And, finally, he is familiar with and somewhat skilled in the use of the tools of visual communication.

An important question that needs to be considered as one examines visual literacy is; Why visual literacy? For years, schools have set aside the skills of visual literacy as "extras" and concentrated on the verbal skills - skills in reading, writing, and speaking. Fransecky and Debes (1972) point out that educators have finally begun to realize that this visual age requires visual as well as verbal skills of everyone and that visual and verbal skill are interconnected.

It is useful to keep in mind a triad of terms as one examines the area of visual literacy. 1) Visual literacy is the attribute we hope to find or must develop in the members of today's society; 2) Visual communication is what such a person is exposed to or might do when appropriate; and 3) Visual technology is the means by which it is done. (Fransecky and Debes, 1972)

It is important that educators keep in mind the difference between what might be called the audiovisual viewpoint and the visual literacy viewpoint. The visual literacy viewpoint adds a new dimension to traditional audiovisual thinking. The audio-visual communicator in education has traditionally been concerned with providing superior messages that would transmit ideas more effectively to students. In other words, the audiovisual viewpoint puts the tools of visual communication into the hands of the teacher; while the visual literacy viewpoint puts the tools of visual communication in the hands of the students and teachers. In visual literacy the emphasis is on the student and what happens to him when he tries to communicate.

Most of the researchers in visual literacy have directed critical attention on the effects of visual literacy training on extending and enriching oral and written language facility, on developing self-concept, and on heightening enviornmental awareness. The researchers have posited that when children are trained to use their existing "passive visual vocabulary", they can handle verbal language processes with more ease and purpose.

Fransecky (1969) conducted a summer project with 100 first-, second-, and third-grade children to determine the impact visual literacy training might have on language skills. The results indicated a superiority in oral language for those students who received visual literacy training. Other results of the project included sharpening of students self-concept and deepening of their enviornmental awareness.

An interesting project in Rochester, New York was reported in <u>Visuals are a Language</u> (1970). Students in Clara Barton School No. 2, when they entered first grade, tested at the bottom for fourteen schools in reading readiness. After a year of visual literacy activities where they used student made super 8 movies along with their reading program, the students were tested again. The results indicated increases in reading skills for the visual literacy group averaged 50 percent higher than the test scores for a control class, as well as sample selection of fourteen other first graders. By comparative tests the first graders in the visual literacy program topped all other first grade classes.

Fransecky (1972) reports that the development of the ability to engage in visual communication activities is related to the development of visual literacy. Strandberg and Griffith (1969) demonstrated that specific instruction and demonstration as to how pictures go together to tell "stories" significantly affect the length and complexity of the language a child uses to describe his pictures.

Jaromin (1970) reported a study on the teaching of grammar and composition in a college prepatory high school with visual literacy techniques. His results indicated that visual literacy techniques had no effect on improvement in grammar but that the quality of the composition work was greatly superior when these techniques were used.

The results of these studies manifest the importance of visual literacy training for the total education of today's student. But, what about the student who receives no visual literacy training? Do students possess different levels of visual literacy competencies? If so, how do we measure visual literacy? Fransecky and Debes (1972) state that handy tests to measure visual literacy competencies just do not exist. In reviewing the literature this writer has concluded that the visual-haptic catagories developed by Lowenfeld is one means of identifying students of different visual ability.

CHAPTER III

METHODOLOGY

This investigation represents a descriptive study of the relationship between the visual aptitude of students and achievement in reading and mathematics. This chapter details the procedural steps involved, beginning with the selection of population.

Selection of Population

The data for this study were collected in the spring semester of 1973-74 academic year at Norman High School, Norman, Oklahoma. The population for this study was divided into two groups. To test hypotheses 1 and 2, the population was made up of a sample of 175 students from the eleventh grade population of 540 who had scores on reading and mathematics achievement tests for that grade. Participation in the study was based on a volunteer basis to satisfy the requirements of the school's administrative staff. This requirement being that students are not forced to participate in a study, but may do so on a voluntary basis. As a result, it was impossible to randomly select from the total eleventh grade population. Therefore, a careful evaluation was made of the total population of eleventh graders to determine if the sample population was representative. Table 1 shows that the percentages of students sampled very closely coincides with the total population. Therefore, the assumption was made that the sample population was indeed representative of the total population of eleventh graders.

TABLE 1

COMPARISON OF SAMPLE POPULATION TO TOTAL POPULATION

Percent Score on Reading Achievement	Percent of Total Population in each Percentile Range	Percent of Sample Population in each Percentile Range
90 - 99	13	15
80 - 89	9	8
70 - 79	8	10
60 - 69	12	13
50 - 59	14	12
40 - 49	10	12
30 - 39	10	9
20 - 29	10	10
10 - 19	8	10
0 - 9	8	5

Since this was an initial study into the relationship of visual aptitude and achievement, it was concluded that the results would provide a foundation for future research in this area. Therefore, the sample was accepted as described in this chapter.

To test hypotheses 3. through 6., the population was made up of the 45 students from the population tested who had achievement test scores for grades 4, 7, and 11. An evaluation of the total population revealed that this population was representative of the total population of eleventh grade students with scores on 4th, 7th and 11th grade achievement tests in the areas of reading and mathematics.

Selection of the Instruments

Visual aptitude for the study was determined by administering the Successive Perception I Test to the 11th grade students who participated in the study. This is a motion picture test developed by Gibson, Gagne and associates (Gibson, 1947), upon the suggestions by Lowenfeld, for use in the World War II Aviation Psychology Programs. Successive Perception I, like Lowenfeld's Integration of Successive Impressions, (Lowenfeld, 1945, p. 102-103) was designed to assess the ability to integrate successive partial impressions of abstract visual stimuli into an accurate scheme or pattern. Lowenfeld's underlying rationale holds that the visual type individual is inclined toward integrating and forming a comprehensible whole from the partial impressions he receives, while the non-visual type ostensibly is satisfied to singly internalize any partial impressions he receives and has little inclination towards "viewing" his impressions as a whole.

Successive Perception I is composed of three practice items and thirty-five test items. For each item, a slot in an opaque field moves over a black pattern set on a gray background, exposing successive parts of a pattern from top to bottom, as illustrated in Figure 2. The pattern is different and varies in complexity from item to item.

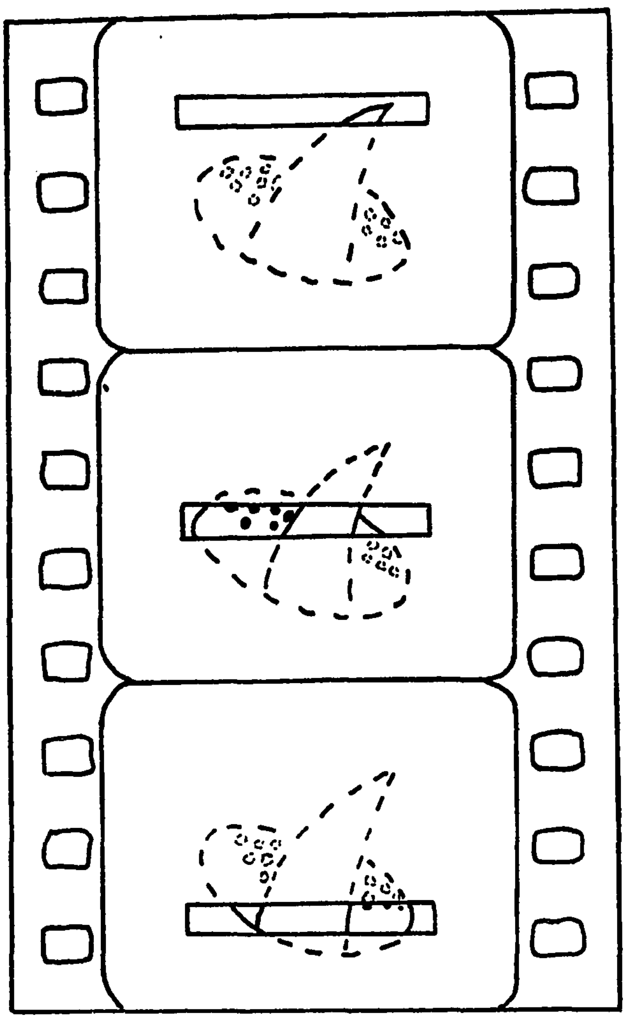


Figure 2.

Stages in a sample item of Successive Perception I Test. The dotted lines are not seen in an actual test item. (Gibson, 1947, p. 88)

After the pattern has been presented in this sequential manner, it appears on the screen in its entirety, along with four similar patterns, which serve as distractors. The five patterns are labeled A through E and are presented as shown in Figure 3. Subjects will indicate recognition of the figure by marking the appropriate space on a standard IBM answer sheet. The test is scored by summing the number of items answered correctly.

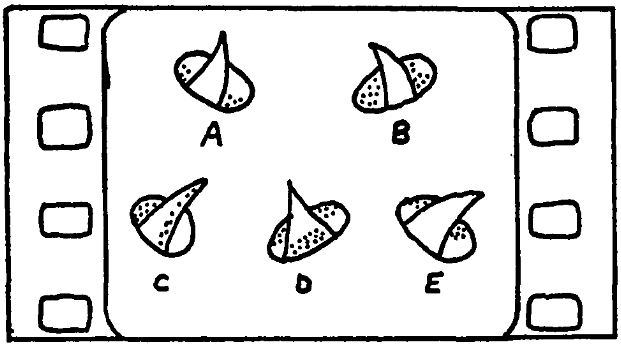


Figure 3.

The five alternative responses corresponding to the sample item. (Gibson, 1947, p. 89)

Since this instrument was developed for use in the Army-Air Force Cadet Program, there was some question as to the suitability for use with 11th grade students. Erickson (1966) used Successive Perception I with 7th grade students and found that the mean test score was 19.03 as compared to a mean score of 20.24 for college students. Since 11th grade students fit between these two groups it seemed that this instrument would be appropriate for this age group. The mean score for 11th graders in this study was 20.50.

This instrument has been used in previous research by Erickson (1966 and 1969) and Clark (1971) to classify students according to visual-haptic aptitude. Reliability coefficients for Successive Perception I are reported in Gibson (1947) at .56. Clark (1971) reports measures of item difficulty and point-biseral correlation.

All subjects in the study were administered the Successive Perception I Test. For the testing of hypotheses 1. and 2., the raw scores on the instrument were used for the computations of the correlations. For the testing of hypotheses 3. through 6., the subjects were assigned to three sub-classes of visual aptitude (high, medium and low) rather than according to their visual-haptic aptitude, as suggested by Lowenfeld and others. The reason being, Successive Perception I measures only visual aptitude and makes no attempt to measure haptic aptitude. Also, the research is not conclusive on what percentages of the general population are visual and which are non-visual. Therefore, those subjects who scored from 24 to 30 on the visual aptitude test were classified as high visual (top 33%), subjects who scored from 20 to 23 were classified as medium visual (middle 33%), and those who scored from 13 to 19 were classified as low visual (low 33%).

Student achievement in reading and mathematics was determined by scores on standardized tests in these areas. To test hypotheses one and two achievement scores for the eleventh grade in reading and mathematics on the Sequential Test of Educational Progress were used. These scores were obtained from the student's test files.

The STEP Reading Test measures five major categories of comprehensive skills, abilities and attitudes: 1) ability to recall ideas, 2) ability to translate ideas and make inferences, 3) ability to analyze motivation, 4) ability to analyze presentation, and 5) ability to critize. (Buros, 1965, p. 1088-1089) There is some question as to whether the five major "scalings for comprehension skills" are major components of reading ability. However, most reviewers are in agreement that the test is outstanding in terms of measuring understanding as opposed to memory, application of principles, skills and abilities involved in interpreting and understanding as opposed to rote memory.

Correlations between STEP Reading and SCAT (School and College Ability Test) Verbal averaged .80 (with a range from .87 to .72) were reported in the STEP Technical Report of 1963. Although the test possesses good content validity, Lohnes and Steeklein (Buros, 1965) report that there is not enough evidence of validity and more studies are needed. Reliability coefficients using Spearman-Brown split-half, Kuder-Richardson (formula 21) and alternate form showed values in high .80's and low .90's for the different levels of the test.

The STEP Mathematics battery are carefully designed to to place emphasis on broad understandings and ability to utilize learned skills in solving new problems rather than merely the ability to handle facts obtained from the lesson materials. Dressel (Buros,1959) reports that the face validity of the test is good and the essential aspect of each item is the measurement of an important mathematics concept. Reliability coefficients reported for the four levels, as determined by Kuder-Richardson (formula 20) run from .83 to .89. Lamke (Buros,1959) states that it is the best test available for competence in mathematics of general education.

Dressel (Buros,1959) reports that standardization of STEP approaches the highest standards of educational measurement. It is recognized that at certain levels, sample sizes are small, but techniques of sampling, equating and norming apparently were not only appropriate but also quite carefully carried out. Norms provided are comprehensive, representive and usable.

In addition to the STEP tests for grade eleven, achievement score on the California Achievement Tests in Reading and Mathematics at grades four and seven were used to test hypotheses three through six. These tests are useful for determining traditional, fundamental skills and content in reading vocabulary and comprehension, as well as reasoning and fundamentals in mathematics. Although the tests measured vocabulary and comprehension in reading and reasoning and fundamentals in mathematics, only the total scores for reading and mathematics were used in this study. The reason being that this study was only interested in total achievement gain in reading and mathematics rather than specific skills within each area.

North (Buros,1959) reports reliability coefficients, using Kuder-Richardson (formula 21) on total reading and mathematics to range from .86 to .96 for the various levels of the test.

Instrumentation

Arrangements were made with the research board of the Norman Public Schools to conduct the study at the high school. The principal of the high school was contacted and arrangements were made for administration of the Successive Perception I Test. Since this test had to be administered to students on a voluntary basis, arrangements were made to have announcements made through the daily bulletin during homeroom as to time and place of the testing. Norman High School operates on a modular schedule and the students were encouraged to come in for the testing during their independent study time. In addition the Psychology and Sociology teachers were contacted by the researcher and the principal and both agreed to allow their students to participate in the study. These are elective courses and because of the nature of the study, the students were encouraged to take part.

The film test was administered several times on different days of the week to allow for as many students as possible to partake. Administration of the test was made in a conference room next to the Social Science resource center. The room was large enough to accomodate twenty-five students comfortably. All students sat in regular chairs and were provided lap boards on which to write. The test was administered in a group setting with the groups ranging from 5 to 20. The room was arranged such that all students were within a range of 10 to 20 feet from the screen. During the administration of the test enough light remained to enable the students to record their answers, and yet it remained dark enough to provide a sharp contrast between the images projected on the screen.

After each student recorded his name and grade level in the appropriate blanks on the answer sheet, the researcher read aloud the directions appearing at the top of the answer sheet (Appendix B). The film was then started. The film contained written instructions similar to those on the answer sheet. No comments were make until the students completed the three practice items. The projector was stopped at this point, and the researcher asked if there were any questions pretaining to the prodedure that was to follow. Again the film was started and no other comments were made until the test was finished. This same procedure was followed for all administrations of the test.

Statistical Design

It was decided that the logical first step in the investigation of visual aptitude and achievement in reading and mathematics was to determine if indeed there was a relationship between visual aptitude and achievement in these curriculum areas. Since Lowenfeld (1957) theorized that as a child approached adolescence his preference toward visual experiences crystalized, it was decided to analyze the relationship between visual aptitude and reading and mathematics achievement at the eleventh grade level. It is at this stage in a child's development (Figure 1) that his visual experiences reach the point of critical awareness.

Ferguson (1971) states that correlation is concerned with describing the degree of relationship between two variables. The first stage objective of this study was to determine the relationship between visual aptitude and achievement in reading and mathematics, therefore, correlations were used to determine the degree of this relationship. The scores on the test instruments were of the interval type, which demand the use of the Pearson product-moment correlation coefficient. (Ferguson, 1971) The following Tables 1 and 2 describe the design for the correlations of reading and mathematics achievement respectively.

It was determined that it would be beneficial to analyze the data to ascertain the relationship between visual aptitude and

and the combined scores of reading and mathematics achievement. Therefore, a multiple correlation was used to determine the degree of this relationship. (Ferguson, 1971) Tables 4 describes the statistical design for multiple correlation.

TABLE 2

STATISTICAL DESIGN FOR THE CORRELATION BETWEEN VISUAL APTITUDE AND READING ACHIEVEMENT

	Visual Aptitude	Reading Achievement
Subjects	X	Y
A_1	X_1	Y_1
A_2	X_2	Y_2
A_3	X_3	Y_3
.	.	.
.	.	.
.	.	.
A_N	X_N	Y_N

N = 175

TABLE 3

STATISTICAL DESIGN FOR THE CORRELATION BETWEEN

VISUAL APTITUDE AND MATHEMATICS ACHIEVEMENT

Subjects	Visual Aptitude X	Mathematics Achievement Z
A_1	X_1	Z_1
A_2	X_2	Z_2
A_3	X_3	Z_3
.	.	.
.	.	.
.	.	.
A_N	X_N	Z_N

N = 175

TABLE 4

STATISTICAL DESIGN FOR MULTIPLE CORRELATION

	Visual Aptitude X	Reading Achievement Y	Mathematics Achievement Z
Visual Aptitude	r_x	r_{xy}	r_{xz}
Reading Achievement	r_{xy}	r_y	r_{yz}
Mathematics Achievement	r_{xz}	r_{yz}	r_z

The second stage in the investigation of visual aptitude and achievement was designed to determine if there was a significant difference in achievement gain for these same students from grades four to seven and seven to eleven when the subjects were grouped according to high, medium, and low visual aptitude. These grade levels were chosen because they coincide with Lowenfeld's (1957) theory that a child moves from an unaware stage to an aware stage in his preference of visual experiences (Figure 1).

Ferguson (1971) points out that situations arise where one or more variables are uncontrolled because of practical limitations associated with the conduct of the experiment. A statistical, rather than an experimental, method may be used to "control" or "adjust for" the effects of one or more uncontrolled variables, and permit, thereby, a valid evaluation of the outcome of the experiment. The analysis of covariance is such a method. Since this was the case for the second stage analysis of the data, four successive analyses of covariance were used which differed only in their independent variable. Subjects scores on fourth grade reading achievement tests served as the dependent variable for the testing of hypothesis 3. Subjects scores on fourth grade mathematics tests, seventh grade reading tests and seventh grade mathematics tests served as the dependent variables for the testing of hypotheses 4, 5 and 6 respectively.

Due to the existence of unequal cell frequencies in the analysis, the procedures of unweighted-means analysis were used exclusively. For the analysis of covariance, Winer (1962, p. 605) makes the following statement:

> Under conditions in which an unweighted-mean analysis is appropriate for an analysis of variance, there is an equivalent unweighted-means analysis appropriate for the analysis of covariance.

The two independent variables, visual aptitude (Factor A) and grade level (Factor B) were used with the dependent variable achievement to produce four 3 X 2 factorial designs (Tables 5, 6, 7 and 8).

TABLE 5

FACTORIAL DESIGN FOR ANALYSIS OF COVARIANCE ON READING ACHIEVEMENT GAIN GRADES FOUR TO SEVEN

		Reading Achievement	
		4th	7th
		Y_1	Y_2
Student's Visual Aptitude	High (a_1)		
	Medium (a_2)		
	Low (a_3)		

Y_1 = Covariate

Y_2 = Dependent variable

TABLE 6

FACTORIAL DESIGN FOR ANALYSIS OF COVARIANCE ON MATHEMATICS ACHIEVEMENT GAIN GRADES FOUR TO SEVEN

		Mathematics Achievement 4th	7th
		Z_1	Z_2
Student's Visual Aptitude	High (a_1)		
	Medium (a_2)		
	Low (a_3)		

Z_1= Covariate
Z_2= Dependent variable

TABLE 7

FACTORIAL DESIGN FOR ANALYSIS OF COVARIANCE ON READING ACHIEVEMENT GAIN GRADES SEVEN TO ELEVEN

		Reading Achievement	
		7th	11th
		Y_2	Y_3
Student's Visual Aptitude	High (a_1)		
	Medium (a_2)		
	Low (a_3)		

Y_2 = Covariate
Y_3 = Dependent Variable

TABLE 8

FACTORIAL DESIGN FOR ANALYSIS OF COVARIANCE ON MATHEMATICS ACHIEVEMENT GAIN GRADES SEVEN TO ELEVEN

		Mathematics Achievement	
		7th	11th
		Z_2	Z_3
Student's Visual Aptitude	High (a_1)		
	Medium (a_2)		
	Low (a_3)		

Z_2 = Covariate
Z_3 = Dependent variable

CHAPTER IV

STATISTICAL ANALYSIS OF THE DATA

The analysis of the data for the study was performed in two stages. The first stage determined the relationship of visual aptitude and reading and mathematics achievement. The second stage determined if there was a significant gain in achievement when students were grouped according to their visual aptitude. The results of these analyses are presented below according to each hypotheses tested.

Test of Hypothesis 1. There is no significant correlation between the student's visual aptitude, as measured by Successive Perception I Test, and reading achievement, as measured by standardized achievement tests.

The correlation between visual aptitude and reading achievement was found to be .23335. With an n = 175, this is a significant correlation at the .05 level of significance. This data does not support the hypothesis of no significant correlation, therefore, the null hypothesis is rejected. From this data we can square the correlation coefficent and state that 5.4 per cent of the variance of reading achievement is predictable from the variance of visual aptitude.

Test of Hypothesis 2. There is no significant correlation between the student's visual aptitude, as measured by Successive Perception I Test, and mathematics achievement, as measured by standardized achievement tests.

The correlation between visual aptitude and mathematics achievement was found to be .27738. With an n = 175 this is a significant correlation at the .01 level of significance. This data does not support the hypothesis of no significant correlation, therefore, the null hypothesis is rejected. From this data one can square the correlation coefficient and state that 7.69 percent of the variance of mathematics achievement is predictable from the variance of visual aptitude.

TABLE 9

MULTIPLE CORRELATION FOR VISUAL APTITUDE AND COMBINED SCORES ON READING AND MATHEMATICS ACHIEVEMENT

	Visual Aptitude	Reading Achievement	Mathematics Achievement
Visual Aptitude	1.0	.23335	.27738
Reading Achievement	.23335	1.0	.67363
Mathematics Achievement	.27738	.67363	1.0

A multiple-correlation was computed on the data to determine if the combined scores on reading and mathematics achievement tests provided a higher relationship than they did individually.

The correlation coefficient for the multiple correlation proved to be .2731, which is significant at the .01 level of significance. This correlation closely matches that of visual aptitude and mathematics, but is slightly higher than the correlation of reading and visual aptitude.

Test of Hypothesis 3. There is no significant difference in reading achievement gain, as measured by standardized test scores, from grades 4 to 7 between high-visual aptitude, medium-visual aptitude and low-visual aptitude students, as measured by Successive Perception I Test.

TABLE 10

Means, Standard Deviations of Subjects Reading Achievement Scores for Grades 4 and 7 and Number of Subjects Per Cell to Test Hypothesis 3.

		4th		7th
	X	93.0000	X	104.6429
High (a_1)	s	14.9523	s	20.1731
	n	14	n	14
	X	93.7143	X	107.6429
Medium (a_2)	s	10.7739	s	14.4602
	n	14	n	14
	X	86.2941	X	103.8823
Low (a_3)	s	9.4985	s	14.7687
	n	17	n	17

TABLE 11

ANALYSIS OF COVARIANCE TABLE FOR HYPOTHESIS 3

Source	DF	YY	Sum- squares (due)	Sum - squares (about)	DF	Mean-Square
Treatment (Between)	2	117.0625				
Error (Within)	42	12332.3125	7217.2852	5115.0273	41	124.7568
Treatment Error (Total)	44	12449.3750	7094.0586	5355.3164	43	
Difference for Testing Adjusted Treatment Means				240.2891	2	120.1445

The covariate analysis revealed an observed F value of 0.963 with 2 and 41 degrees of freedom for the adjusted mean square ratio. These data tend to support the hypothesis of no significant difference between reading achievement gain for grades 4 to 7 with the three levels of visual aptitude. The null hypothesis was therefore held tenable.

Test of Hypothesis 4. There is no significant difference in mathematics achievement gain, as measured by standardized test scores, from grades 4 to 7 between high-visual aptitude, medium-visual aptitude and low-visual aptitude students, as measured by Successive Perception I Test.

TABLE 12

Means, Standard Deviations of Subjects Mathematics Achievement Scores for Grades 4 and 7 and Number of Subjects Per Cell to Test Hypothesis 4.

		4th		7th
High (a_1)	X	74.1286	X	79.5000
	s	9.8473	s	23.0395
	n	14	n	14
Medium (a_2)	X	74.0000	X	83.0000
	s	10.8100	s	16.6175
	n	14	n	14
Low (a_3)	X	65.5882	X	77.7647
	s	7.6010	s	17.0381
	n	17	n	17

TABLE 13

ANALYSIS OF COVARIANCE TABLE FOR HYPOTHESIS 4

Source	DF	YY	Sum-squares (due)	Sum-squares (about)	DF	Mean-Square
Treatment (Between)	2	214.2500				
Error (Within)	42	16232.5625	7082.6680	9149.8945	41	223.1682
Treatment Error (Total)	44	16446.8125	6615.4492	9831.3633	43	
Difference for Testing Adjusted Treatment Means........				681.4688	2	340.7344

The covariate analysis revealed an observed F value of 1.527 with 2 and 41 degrees of freedom for the adjusted mean square ratio. These data tend to support the hypothesis of no significant difference between mathematics achievement gain for grades 4 to 7 with the three levels of visual aptitude. The null was therefore held tenable. (See Table 13 for Analysis of Covariance Table)

Test of Hypothesis 5. There is no significant difference in reading achievement gain, as measured by standardized achievement test scores, for grades 7 to 11 between high-visual aptitude, medium-visual aptitude and low-visual aptitude students, as measured by Successive Perception I Test.

TABLE 14

Means, Standard Deviations of Subjects Reading Achievement Scores for Grades 7 and 11 and Number of Subjects Per Cell to Test Hypothesis 5.

		7th		11th
High (a_1)	X	104.6429	X	294.7141
	s	20.1731	s	18.5425
	n	14	n	14
Medium (a_2)	X	107.6429	X	297.6428
	s	14.4602	s	14.9802
	n	14	n	14
Low (a_3)	X	103.8823	X	290.1763
	s	14.7686	s	14.0569
	n	17	n	17

TABLE 15

ANALYSIS OF COVARIANCE TABLE FOR HYPOTHESIS 5

Source	DF	YY	Sum-squares (due)	Sum-squares (about)	DF	Mean-Square
Treatment (Between)	2	439.0000				
Error (Within)	42	11315.0000	8198.2188	3116.7813	41	76.0190
Treatment Error (Total)	44	11754.0000	8455.6484	3298.3516	43	
Difference for Testing Adjusted Treatment Means........				181.5703	2	90.7852

The covariate analysis revealed an observed F value of 1.194 with 2 and 41 degrees of freedom for the adjusted mean square ratio. These data tend to support the hypothesis of no significant difference between reading achievement gain for grades 7 to 11 with the three levels of visual aptitude. The null hypothesis is therefore held tenable. (See Table 15 for Analysis of Covariance Table)

Test of Hypothesis 6. There is no significant difference in mathematics achievement gain, as measured by standardized test scores, from grades 7 to 11 between high-visual aptitude, medium-visual aptitude and low-visual aptitude students, as measured by Successive Perception I Test.

TABLE 16

Means, Standard Deviations of Subjects Mathematics Achievement Scores for Grades 7 and 11 and Number of Subjects Per Cell to Test Hypothesis 6.

		7th		11th
High (a_1)	X	79.5000	X	276.7147
	s	23.0395	s	13.6787
	n	14	n	14
Medium (a_2)	X	83.0000	X	279.7141
	s	16.6175	s	13.1462
	n	14	n	14
Low (a_3)	X	77.7647	X	275.6470
	s	17.0381	s	10.0365
	n	17	n	17

TABLE 17

ANALYSIS OF COVARIANCE TABLE FOR HYPOTHESIS 6

Source	DF	YY	Sum- squares (due)	Sum- squares (about)	DF	Mean- Square
Treatment (Between)	2	132, 0000				
Error (Within)	42	6751. 0000	303. 2498	3719. 7502	41	90. 7256
Treatment Error (Total)	44	6883. 0000	3137. 1113	3745. 8887	43	
Difference for Testing Adjusted Treatment Means.........				26. 1384	2	13. 0692

The covariate analysis revealed an observed F value of .144 with 2 and 41 degrees of freedom for the adjusted mean square ratio. These data tend to support the hypothesis of no significant difference in mathematics achievement gain for grades 7 to 11 with the three levels of visual aptitude. The null hypothesis is therefore held to be tenable. (See Table 17 for Analysis of Covariance Table)

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The research reported herein was undertaken to study the relationship of visual aptitude and student achievement in the curriculum areas of reading and mathematics. The subjects' level of visual aptitude was identified by their score on Successive Perception I (Gibson, 1947). The subjects' level of achievement was determined by their scores on standardized achievement tests in reading and mathematics. Achievement scores for the eleventh grade were based on scores from the Sequential Test of Educational Progress, while scores for fourth and seventh grade were based on scores from the California Achievement Test.

Previous research in this area was centered around visual aptitude and such curriculum areas as art and mechanical drawing. Very little effort had been made to determine if there was a relationship between visual aptitude and achievement in other areas of the curriculum. The problem of the present study was two fold:

- first, to determine the degree of relationship between visual aptitude and achievement in the curriculum areas of reading and mathematics.

-second, to determine the relationship of visual aptitude and achievement gain throughout a student's school program.

The results of the study were analysized in two stages. For the analysis of the relationship between visual aptitude and achievement, correlations were used. In the second stage, the experimental design for the second stage was a 3 x 2 factorial analysis of covariances that used student's visual aptitude as factor A, grade level as factor B. Four repeated measures of the following design may be represented graphically as follows:

	b_1 X	b_2 Y
a_1		
a_2		
a_3		

For the analysis of covariance, subjects were assigned to the three levels of Factor A (high-visual aptitude, medium-visual aptitude, and low-visual aptitude) on the basis of their scores on Successive Perception I Test (Gibson, 1947). Subjects achievement scores were assigned for grade levels 4, 7 and 11 to test their gain in the following combinations: 1) Reading 4th to 7th, 2) Mathematics 4th to 7th, 3) Reading 7th to 11th, 4) Mathematics 7th to 11th.

All subjects in this research study were members of the eleventh grade class enrolled at Norman High School, Norman, Oklahoma. The sample for the first stage of the study consisted of 175 male and female students, selected on a voluntary basis from the total population of 540 eleventh graders. For the second stage, the population consisted of the 45 students from the first stage population who had achievement scores for grades 4, 7, and 11. There was no observable factors that would indicate that the sample population was markedly different from eleventh grade students who might be randomly selected from other schools of communities.

All hypotheses were tested at the .05 level of significance. The following findings were obtained:

1. There was a significant positive correlation between the student's visual aptitude and achievement in reading as measured by standardized achievement scores for grade eleven.

2. There was a significant positive correlation between the student's visual aptitude and achievement in mathematics as measured by standardized achievement scores for grade eleven.

3. There was no significant difference in reading achievement gain from grades four to seven when the students were grouped according to high, medium and low levels of visual aptitude.

4. There was no significant difference in mathematics achievement gain from grades seven to eleven when the students were grouped

according to high, medium and low levels of visual aptitude.

5. There was no significant difference in reading achievement gain from grades seven to eleven when the students were grouped according to high, medium and low levels of visual aptitude.

6. There was no significant difference in mathematics achievement gain from grades seven to eleven when the students were grouped according to high, medium and low levels of visual aptitude.

Conclusions and implications

While generalizations from the findings must be tempered by inherit limitations of the study, there are several conclusions that may be posited. First, there does appear to be a significant relationship between visual aptitude, as measured by Successive Perception I Test, and achievement in reading and mathematics, as measured by scores on standardized achievement tests, at grade eleven. In other words, students who possess high visual aptitude may be expected to become better achievers in reading and mathematics.

These findings would tend to indicate that more emphasis on the development of the student's visual aptitude at an early age might improve his achievement in school, especially in the areas of reading and mathematics. They also lend support to the visual literacy research which has reported an improvement in reading skills when the students are engaged in visual literacy activities.

Although the parameters of visual aptitude have not yet been clearly defined, the results of the first stage of this investigation would tend to indicate that some emphasis toward the development of the student's ability to integrate and form comprehensible wholes from partial impressions be instrumented into the school curriculum. This would mean an emphasis on methodology in this area at both the pre- and in-service levels of teacher preparation. Recent developments in the area of visual literacy have provided educators with methodology and techniques for the improvement of visual skills relative to reading achievement, however, there appears to be a need for the development of such activities relative to mathematics achievement.

The second stage of this investigation did not indicate a significant gain in reading and mathematics achievement, as measured by standardized test scores, from grades four to seven and seven to eleven when the students were grouped according to high-visual aptitude, medium-visual aptitude and low-visual aptitude, as measured by Successive Perception I Test. However, a close examination of the mean scores, indicate a gain in achievement at all grade levels in both reading and mathematics. This gain seems to be more profound for the medium and low visual aptitude groups in both reading and mathematics.

The decline of mean scores between the high and medium visual aptitude groups is puzzling to the researcher. This result, however, could be accounted for by the fact that for this study the students were grouped according to high, medium, and low visual aptitude with 33 percent in each group rather than according to the percentages reported by Lowenfeld (1945). It was felt at the outset of this study that Lowenfeld's percentages were inconclusive and that research needed to be carried out using the percentages outlined in this study.

The results of this study clearly indicate that visual aptitude has some relationship to achievement in reading and mathematics certain grade levels, but, it also denotes that the parameters of visual aptitude and visual skills are not clearly defined. This would imply that more research in this area is greatly needed.

Recommendations for Future Research

As mentioned at the outset of this study, this was a preliminary study into the relationship of visual aptitude and student achievement in reading and mathematics. Hopefully, the real value of this study will be demonstrated by people who will refine and improve on the findings by further research in this area. Future research with respect to visual aptitude and its relationship to the teaching-learning process might be directed at questions such as:

1. Would the findings found in the present investigation hold if the second stage of analysis were replicated using Lowenfeld's

(1945) percentages for the grouping of students according to visual aptitude?

2. Would the findings found in the present investigation hold under replication when the achievement scores for grade eleven were the same test as for grades four and seven?

3. Would the findings found in the present investigation hold under replication with a population selected from a larger parameter (regional, state, or national)?

4. How does visual aptitude relate to developments in the area of visual literacy?

5. What is the relationship of visual aptitude to achievement in other areas of the curriculum such as spelling, science, etc.?

6. How does visual aptitude relate to achievement when various visual media are used as the mode of presentation (es. films, film-strips, slides, etc.)?

7. What other dimensions of visual aptitude may be related to school learning?

8. Can these be influenced through school experiences?

9. What forms of instruction, curriculum... are used to influence the development of these visual aptitudes.

The previous questions point to obvious aspects that would appear to warrent investigation. It is hoped that future research is undertaken to attempt to answer these and other questions relative to visual aptitude and the teaching-learning process.

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APPENDIX A

SUMMARY OF LOWENFELD'S TEST BATTERY OF VISUAL - HAPTIC APTITUDE

Lowenfeld (1945) presented a battery of five tests which were designed to descriminate between persons whose tendency is to use their eyes as the main intermediaries for their sense impressions and those who, though with normal sight, do not use their eyes but are more concerned with those perceptions that derive from haptical experiences. His Tests for Visual and Haptic Aptitude included:

1. Test of Integration of Successive Impressions. One factor in visual observation is the ability to see first the whole without the awareness of details, then to analyze it into detailed or partial impressions and to build these parts up again into a new synthesis of the whole. This test was designed to measure the ability of a person to integrate partial impressions, which are perceived successively, into a whole. According to Lowenfeld, this ability is more prevalent in people who are visually minded.

2. Test of Subjective Impressions (Draw a Table). In this test the subject is required to draw certain objects resting on a table. According to Lowenfeld, a visual person will respond by drawing the table in perspective, while the haptic person will respond according to his emotional or subjective impressions of the objects and change or ignore the perspective mode of representing the table. Another

version of this test requires the subject to respond to a series of questions concerning the number of floors contained in a building with which the subject is personally familiar. His response usually denotes visual, objective imagery (mentally seeing the building from outside as a spectator) or haptic, subjective impressions (personally climbing each set of stairs in the building).

3. Test of Visual vs Haptic Word Association. Here the test deals with words which incite associations equally from visual and haptic experience. Visual experience usually refers to things outside which are perceived by ocular means while haptic experiences usually refer to body-self. A series of twenty words were chosen which could be interpreted readily by either type. For example, you can "walk fast" but also "walk on the floor". "Walking fast" conveys as subjective (body-self) involvement, but "walk on the floor" conveys more objective, visual perception of outside objects.

4. Visualization of Kinesthetic Experience. This test is based on the apparent tendency for visually minded persons to transform kinesthetic and tactile impressions into visual experiences. The haptic person has a tendency to remain content with tactile and kinesthetic impressions in themselves. For this test Lowenfeld used different shapes of geometric figures of increasing complexity, and required the subject to trace the edges or contours of the figure while blindfolded. Afterward, visual types could identify the geometric figure, when

presented with other similar types, more easily than the haptic types.

5. Test of Tactile Impressions. This test was designed to measure a persons ability to recognize figures which are perceived through tactile experience. The subject is required to identify cardboard shapes by touching, holding, and moving each single shape in his hand. Afterward, he was asked to choose the matching shape from a series of drawn shapes. When the subject identified the shapes correctly he was given haptic scores.

Results of the Tests. Lowenfeld administered this battery of tests to 1,128 subjects with the following results. 47% were identified as clearly visual, 23% as haptic, and 30% as indeterminate.

APPENDIX B

NAME ________________ GRADE ____________

SUCCESSIVE PERCEPTION TEST I

Answer sheet

DIRECTIONS: The following are multiple choice questions. Answer all questions as no extra penalty will be assessed against wrong answers.

You will be presented with several moving pictures. Each of the moving pictures will be followed by five still pictures. You are to identify the still picture that looks like the moving picture. Place the CAPITAL letter (A,B,C,D or E) in the blank space provided for each answer.

Pictures one, two and three are for practice. They do not count toward the final score. Good luck! Do the best you can!

1. _____	9. _____	19. _____	29. _____
2. _____	10. _____	20. _____	30. _____
3. _____	11. _____	21. _____	31. _____
	12. _____	22. _____	32. _____
	13. _____	23. _____	33. _____
4. _____	14. _____	24. _____	34. _____
5. _____	15. _____	25. _____	35. _____
6. _____	16. _____	26. _____	36. _____
7. _____	17. _____	27. _____	37. _____
8. _____	18. _____	28. _____	38. _____

APPENDIX C

TABLE 18

SCORES FOR GRADE ELEVEN ON VISUAL APTITUDE, READING ACHIEVEMENT, AND MATHEMATICS ACHIEVEMENT

Student No.	Visual Aptitude	Reading Achievement	Mathematics Achievement
1	30	303	284
2	30	319	296
3	29	317	295
4	29	299	279
5	28	296	279
6	28	255	261
7	27	310	288
8	27	303	303
9	27	304	293
10	27	301	286
11	26	296	284
12	26	299	290
13	26	311	281
14	26	299	279
15	26	315	284
16	26	291	283
17	25	323	296
18	25	307	287
19	25	310	282
20	25	280	273
21	25	277	245
22	25	288	276
23	25	268	274
24	25	261	269
25	24	290	276
26	24	286	276
27	24	298	273
28	24	301	303
29	24	280	264
30	24	317	287
31	24	253	236
32	24	280	269
33	24	292	276
34	24	282	276
35	24	306	293
36	24	319	297
37	24	321	290
38	24	313	286

Student No.	Visual Aptitude	Reading Achievement	Mathematics Achievement
39	23	273	271
40	23	296	290
41	23	298	274
42	23	286	276
43	23	303	281
44	23	323	299
45	23	301	286
46	23	298	271
47	23	288	282
48	23	295	281
49	23	323	290
50	23	286	271
51	23	313	284
52	23	296	281
53	23	299	273
54	23	284	286
55	23	298	266
56	23	267	246
57	22	275	245
58	22	307	295
59	22	267	266
60	22	315	295
61	22	292	282
62	22	323	286
63	22	301	293
64	22	317	287
65	22	288	273
66	22	310	293
67	22	315	290
68	22	313	273
69	22	304	287
70	22	304	303
71	22	290	257
72	22	290	273
73	22	249	245
74	21	307	276
75	21	273	249
76	21	273	276
77	21	311	282
78	21	290	274
79	21	315	284
80	21	276	273
81	21	276	269
82	21	290	281

Student No.	Visual Aptitude	Reading Achievement	Mathematics Achievement
83	21	280	282
84	21	273	264
85	21	273	266
86	21	311	286
87	21	271	275
88	21	286	283
89	21	298	279
90	21	273	271
91	20	311	281
92	20	286	276
93	20	275	249
94	20	290	274
95	20	296	279
96	20	280	282
97	20	295	276
98	20	301	286
99	20	315	273
100	20	290	266
101	20	291	257
102	20	317	289
103	20	323	293
104	19	301	279
105	19	295	287
106	19	264	264
107	19	277	274
108	19	292	249
109	19	317	292
110	19	276	288
111	19	284	273
112	19	286	261
113	19	310	288
114	19	295	279
115	19	313	303
116	19	298	276
117	19	323	303
118	19	310	288
119	19	296	282
120	19	286	283
121	19	292	284
122	19	291	274
123	19	311	276
124	19	296	273
125	19	310	283
126	19	263	274
127	22	267	266

Student No.	Visual Aptitude	Reading Achievement	Mathematics Achievement
128	18	286	266
129	18	288	266
130	18	286	261
131	18	306	281
132	18	282	257
133	18	264	283
134	18	282	287
135	18	286	261
136	18	276	276
137	17	280	266
138	17	273	274
139	17	290	257
140	17	280	276
141	17	307	271
142	17	280	245
143	17	304	281
144	17	261	261
145	17	276	257
146	17	286	276
147	17	282	271
148	17	282	276
149	17	273	271
150	17	286	276
151	16	280	273
152	16	313	288
153	16	284	266
154	16	302	273
155	16	292	269
156	16	301	284
157	16	271	279
158	16	251	266
159	15	280	273
160	15	267	272
161	15	304	274
162	15	290	269
163	15	303	281
164	15	307	282
165	14	284	245
166	14	311	281
167	14	292	273
168	13	282	279
169	14	299	279
170	13	311	296

Student No.	Visual Aptitude	Reading Achievement	Mathematics Achievement
171	12	274	236
172	12	303	273
173	11	264	271
174	8	268	257
175	7	276	261

APPENDIX D

TABLE 19

SCORES FOR HIGH-VISUAL APTITUDE GROUP ON READING AND MATHEMATICS ACHIEVEMENT FOR GRADES FOUR, SEVEN AND ELEVEN

Student No.	Visual Aptitude	Reading Achievement 4th	7th	11th	Mathematics Achievement 4th	7th	11th
1	24	106	136	317	84	99	287
2	24	65	59	253	56	35	236
3	24	99	113	292	71	114	276
4	24	84	96	280	61	65	264
5	27	93	99	301	74	70	286
6	24	93	111	290	89	87	276
7	24	99	103	298	73	85	273
8	29	100	99	299	84	92	279
9	28	96	99	296	65	45	279
10	24	112	133	321	71	112	290
11	26	97	113	311	76	70	284
12	24	91	122	306	82	95	293
13	25	57	71	261	67	54	269
14	26	110	111	301	89	90	282

TABLE 20

SCORES FOR MEDIUM-VISUAL APTITUDE GROUP ON READING AND MATHEMATICS ACHIEVEMENT FOR GRADES FOUR, SEVEN AND ELEVEN

Student No.	Visual Aptitude	Reading Achievement 4th	7th	11th	Mathematics Achievement 4th	7th	11th
1	22	101	112	310	89	99	293
2	23	96	107	301	71	85	286
3	22	91	126	315	78	83	290
4	22	103	119	313	76	70	273
5	21	84	86	276	71	99	273
6	23	105	102	288	84	102	282
7	22	77	95	290	47	50	257
8	21	84	90	273	60	68	249
9	23	69	90	286	65	57	271
10	21	100	119	315	76	99	288
11	22	103	125	307	87	103	295
12	23	101	108	296	80	85	290
13	22	103	132	317	81	90	287
14	21	95	96	280	71	72	282

TABLE 21

SCORES FOR LOW-VISUAL APTITUDE GROUP ON READING AND MATHEMATICS ACHIEVEMENT FOR GRADES FOUR, SEVEN AND ELEVEN

Student No.	Visual Aptitude	Reading Achievement 4th	7th	11th	Mathematics Achievement 4th	7th	11th
1	15	88	83	280	54	70	273
2	18	65	86	264	73	79	283
3	17	77	102	290	58	56	257
4	19	67	94	277	76	79	274
5	13	82	115	282	63	76	279
6	16	100	115	292	69	112	269
7	19	97	102	310	65	88	288
8	19	113	126	323	84	100	297
9	19	103	131	310	67	95	288
10	18	65	86	286	58	50	266
11	19	89	119	280	60	66	273
12	16	75	79	280	58	70	273
13	17	80	100	286	67	74	276
14	15	88	115	303	73	102	281
15	18	100	100	288	61	66	266
16	18	85	102	286	69	54	261
17	19	93	111	296	60	85	282