DOCUMENT RESUME

ED 119 873 PS 008 468

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TITLE Sequenced and Non-Sequenced Concept Learning of Symmetry by High and Low Visualizers: An Experimental Study with Fourth Grade Children in Art Education Based on a Systems Model.
PUB DATE 8 Apr 74
NOTE 37p.; Paper presented at the National Art Education Conference (Chicago, Illinois, April 8, 1974)

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage
DESCRIPTORS Art Appreciation; *Art Education; *Discrimination Learning; *Elementary Education; Filmstrips; Grade 4; Imagery; Learning Processes; *Nonverbal Ability; *Sequential Learning; Symmetry; Teaching Methods; Visual Discrimination; Visual Learning

ABSTRACT

This study established a controlled instructional procedure for visual concept learning in a school setting and investigated the possibility that an ability trait difference could affect visual learning of the concept. A total of 84 high visualizers and 84 low visualizers were selected from 629 fourth grade children according to their scores on two tests of visualizing ability. Subjects were randomly assigned to three treatment groups: (1) the sequenced learning group viewed a sequenced filmstrip containing instruction on the concept of symmetry; (2) the trial-and-error group viewed a trial-and-error filmstrip presenting the same concept; and (3) the control group saw no filmstrip. Following treatment, each group was given a test of concept mastery and a test of the transfer of that mastery to identifying symmetry in works of art. Results indicate that: (1) differing degrees of visualizing ability can be identified; (2) visualizing ability is strongly related to success in acquiring the concept of symmetry in visual arts; (3) the ability to identify symmetry in examples of visual art can be learned by both high and low visualizers; (4) a greater degree of transfer of this ability is achieved by high visualizers; and (5) the sequenced presentation was more effective than the trial-and-error presentation. (Author/ED)

SEQUENCED AND NON-SEQUENCED CONCEPT LEARNING OF SYMMETRY BY HIGH AND LOW VISUALIZERS: AN EXPERIMENTAL STUDY WITH FOURTH GRADE CHILDREN IN ART EDUCATION BASED ON A SYSTEMS MODEL

by

Bobby Louise Rowe

Paper Presented at the
National Art Education Association Conference
Chicago, Illinois
April 8, 1974

INTRODUCTION

A visualizing ability trait has been specifically investigated in the field of psychology since the nineteenth century. It began under the term "imagery."

Individual differences in ability to imagize have been detected and mused over in the field of psychology at least since the identification of the trait in studies by Galton, James, and Fechner.[1] Visualization has been consolidated as a factor to be dealt with in psychology in ways equally as intriquing as those which probe the verbalization processes.

Art education seems to be an appropriate field for the study of visualization or imagery. Both Herbert Read and Rudolf Arnheim stimulated considerations of visual imagery in art functioning through their writings.[2] Whereas imagistic processes being investigated today are not considered the indeterminable processes proposed by former meanings of "imagination," they are not solely in reference to visual acuity either. The ability to see, anatomically, and the ability to hold the visualization or image in short or long term memory storage for further use are both components of the process. Image selection,

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[1]Francis Galton, Inquiries into Human Faculty and Its Development (London: J. M. Dent, 1833); William James, Principles of Psychology (New York: Henry Holt and Co., 1890); G. T. Fechner, Elements of Psychology (Leipzig: Beitkoph and Haertel, 1860).

[2]Herbert Read, Education Through Art (New York: Pantheon Books, Inc., 1958), Chapter III, "Perception and Imagination", Rudolf Arnheim, Art and Visual Perception (Berkeley, California: University of California Press, 1954).

image manipulation, and image retention can all be considered as functions of the art experience and research on the abilities to use these processes in art performance is needed.

RATIONALE FOR INVESTIGATION OF THE VISUALIZATION TRAIT

Early in the twentieth century, the topic of imagery and thought processes was widely investigated and mused. The determination of a symposium on imagery in 1927, directed by F. C. Bartlett (at that time editor of the British Journal of Psychology) was proposed, and results were published.[3] Invited as the two other panel members with Bartlett were Aveling and Pear who held opposing views on the influence of imagery upon thinking. Pear had previously said that "the mentality of most ordinary persons is seriously affected by their predominant imagery."[4]

Aveling and Bartlett, on the other hand, raised questions of "the images being the product of thought"[5] after which the definition of "thought" was pursued in such a context. The fact of "negligible" imagery processes in some subjects and the process of "inner speech" (later examined by Watson) became issues. Bartlett declared that "words are more flexible than visual images" and speculated that the high imagizer became entangled in description of his images rather

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[3]F. Aveling, "Relevance of Visual Imagery to the Process of Thinking, III," British Journal of Psychology, XVIII (1927), 15-22; T. H. Pear, "Relevance of Visual Imagery to the Process of Thinking, I," British Journal of Psychology, XVIII (1927), 15-22.

[4]T. H. Pear, "Is Thinking Merely the Action of Language Mechanisms?" Journal of Psychology, III, No. 11 (1920), 72-80.

[5]F. C. Bartlett, "Relevance of Visual Imagery to the Process of Thinking, II," British Journal of Psychology, XVIII (1927), 15-22.

than moving in on the point of a problem. In the background of this controversy J. B. Watson, behaviorist and objectivist, who had appeared on a symposium earlier (1920) with these men, had declared arbitrarily: "thinking is largely a verbal process."[6] The influence of behavioristic psychology overwhelmed the study of imagery until the 1960's.

From 1930-1960 very little about the topic was of concern to scientists. The passion for objectivity, observation, and laboratory experiences overshadowed even statistical surveys such as Galton's breakfast questionnaire. Galton's work had detected a wide continuum of abilities to imagize and verified the aptitude as an ability trait.[7] Experiments with findings concerning imagery almost disappeared from studies in psychology. The title of Holt's article[8] "Imagery: The Return of the Ostracized" was very appropriate to a new focus on the subject by 1964.

In previous studies the tendency to have and use images in thinking was proposed to be measurable by Short[9] who gave mental tasks to subjects from visual stimuli and recorded the result of a manipulation or use of the image. His work extended further into objective measurement by use of instruments recording electrical activity in the visual association areas of the cortex and in respiratory rhythms.

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[6]J. B. Watson, "Is Thinking Merely the Action of Language Mechanisms?" British Journal of Psychology, V, No. 11 (1920), 87-104.

[7]Galton, Inquiries into Human Faculty and Its Development. Op. cit. p. 60.

[8]R. R. Holt, "Imagery: The Return of the Ostracized," American Psychologist, 1964, 19, pp. 254-264.

[9]P. L. Short, "The Objective Study of Mental Imagery," The British Journal of Psychology, XVIII (July, 1953), 37-51.

Visualists and verbalists became "types" as some subjects, having mainly auditory facility, recorded different respiratory activity when performing mental tasks requiring visual imagery. EEG studies verified a correlation between the mental activity which occurred while the subject solved visual problems in contrast to other types of problems and in respiratory activity at this time for subjects with different imagistic or verbal aptitudes.

One of the most prolific researchers in the area of imagery, recently, has been Allan Paivio.[10] His account of the decline of psychological investigations of imagistic thinking is recorded in an article in the Psychological Review.[11]

> Watson seemed to reject the notion of nonverbal schemata or images partly on philosophical grounds and partly on the basis of the experimental evidence then available. He concluded that mental images are mere ghosts, without significance. The mediating functions that had been attributed to images in thought and memory became the burden of implicit verbal responses or their gestural substitutes. A verbal emphasis has been generally apparent in research on mediated transfer and generalization, clustering in free recall, association in language, and natural language mediators. The possible role of imagery in such phenomena has been largely ignored.

The Paivio studies concerning the contributions of verbal and pictorial factors to the degree of efficiency with which children learn paired associates have explored information processing of knowledge which poses these questions concerning visual vs. verbal facilitation.

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[10] Allan Paivio, Imagery and Verbal Processes (New York: Holt, Rinehart and Winston, 1971), p. 492.

[11] Allan Paivio, "Mental Imagery in Associative Learning and Memory," Psychological Review, LXXVI (May, 1969), 241-259.

1. Are covert processes, underlying pictorial facilitation, image based?
2. Are the covert processes underlying pictorial facilitation of verbal kinds?
3. Are the two processes independent of one another but co-dependent on some unknown third process?

At one point in the development of the Paivio investigations a suggestion concerning the abilities of the subjects can be noticed.[12] The studies did not divide subjects as high and low visualizers as a test factor.

In other studies Rohwer, Lynch, Suzuki and Levin contend that the results of their studies in this area do not permit a choice among visual-verbal alternatives and there is "no indication in the present results that verbal processes are primary."[13] It is important to emphasize that in many of the preceeding kinds of studies, the problem is one of symbolic transformation from a non-verbal to a verbal mode of thinking. Experimental investigations in art education have previously employed this stimulus-response relationship to obtain measured results.[14]

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[12] Marcia Dilley and Allan Paivio, "Pictures and Words as Stimuli and Response Items in Paired Associate Learning of Young Children," Journal of Experimental Child Psychology, VI (1968), 231-240.

[13] William Rohwer, Steve Lynch, Nancy Suzuki, and Joel Levin, "Verbal and Pictorial Facilitation of Paired Associate Learning," Journal of Experimental Child Psychology, V, No. 6 (1967), 291-302.

[14] Brent Wilson, "An Experimental Study Designed to Alter Fifth and Sixth Grade Students' Perceptions of Painting," Studies in Art Education, VIII, No. 1 (1966), 33-42; Nancy J. Douglas and Julia Schwartz, "Increasing Awareness of Art Ideas of Young Children through Guided Experiences with Ceramics," Studies in Art Education, VIII, No. 2 (Spring, 1967), 2-9.

Cromer's study in art education found that adolescents with concrete-imagistic-inductive thinking abilities without corresponding development of abstract-verbal-deductive thinking abilities resulted in restricted development in art performance.[15]

Concept learning has also been investigated in these dual mode studies. Stewart, as a result of his findings in investigations of imagery, states:

> . . . recent studies in visual imagery have reported differences in recall performance and concept attainment between children of high and low imaging ability. High imagery children are better able to remember pictures than are low imagery children whereas low imagery children form and recognize concepts more quickly than do high imagery children.[16]

A study by Kuhlman[17] examined these problems in childhood. Her work hypothesizes that high capabilities in imagery impede children's abilities to abstract qualities for use in generalizations. High imagistic children excelled in learning the names of objects but had difficulty with concept classifications.

Are learners who are high visualizers less able to use abstract thinking than low visualizers if the learning mode and transfer tasks are both based in intellectual-visual processes rather than verbal ones? Also, the question of the low visualizer's capabilities for

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[15] J. L. Cromer, "An Experimental Study of the Effects of Verbal Language Conditions on Art" (unpublished dissertation, Arizona State University, 1972).

[16] J. C. Stewart, "An Experimental Investigation on Imagery," Dissertation Abstract, XXVII (1966).

[17] Clementine (Hollenberg) Kuhlman, "Functions of Visual Imagery in the Learning and Concept Formation of Children," Child Development, XLI (1970), 1003-1015.

learning in the visual mode emerges as an issue. Art education could offer a base for studies which further investigate these and other relevant questions which are pertinent to the problem of art learning processes.

RATIONALE FOR INVESTIGATION OF THE SEQUENCED-NONSEQUENCED TEACHING METHODOLOGY

Whether or not visual concepts need to be sequenced in a hierarchical structure in order to be learned is a question for program planners in art education. Are the subordinate concepts in a learning sequence of a visual nature subliminally known and capable of being retrieved, organized and applied to the use of a defined concept, or must the subordinate concepts in a learning sequence be presented in an organized manner in order to achieve maximum learning efficiency and be used effectively by the student.

Locating pieces of research in the area of sequencing concept structure in art education gives sparse results. Studies can be found in the field which show evidences of differences in results of instructional methodologies.[18] Also studies can be found that establish the fact that behaviors in visual discriminations and concept learnings in art are capable of change.[19] Hierarchies of concept sequences in art content of a visual nature need empirical underpinnings in the field.

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[18]Ronald W. Neperud, "An Experimental Study of Visual Elements, Selected Art Instruction Methods, and Drawing Development at the Fifth Grade Level," Studies in Art Education, Vol. 8, No. 2 (Spring, 1966), pp. 3-15.

[19]Gilbert Clark, An Investigation of Children's Abilities to Form and Generalize Visual Concepts from Visually Complex Art Reproductions (Washington, D.C.: Office of Education, Project #0-1-060).

In Conditions of Learning[20] Gagne develops the theoretical possibilities of a hierarchy of learning capabilities, giving detailed examples of specific applications to school tasks. Learning processes have a structure with defined instructional methodologies and expected behavioral outcomes. These different classes of behaviors are dependent upon their positions in a hierarchy of learning levels and have been systematized, and elaborated upon by Gagne who first saw potential for setting conditions of learning in concordance with these levels.[21] These levels or domains of learning "are needed to distinguish the parts of a content area which are subject to different instructional treatments."[22]

The learning of discrimination processes are different from the process of learning concepts, the process of rule learning, or of problem solving. These learning processes cut across subject content areas and can be made applicable to any one of them, such as art, mathematics and science. Another reason for making considerations of domains of learning in program planning is, "that they [domains] require different techniques of assessment of learning outcomes. One cannot use a single way of measuring what has been learned."[23] The

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[20]Robert M. Gagne, The Conditions of Learning (2nd ed.; New York: Holt, Rinehart and Winston, 1970).

[21]Robert M. Gagne, "The Acquisition of Knowledge," Psychological Review, Vol. 69, 1962, pp. 355-365.

[22]Robert M. Gagne, "Domains of Learning," President's Address, American Educational Research Association, February, 1971.

[23]Ibid., p. 6.

program planner encounters an additional factor of measurement in needing to know not only how well something has been learned but how widely can this result be generalized? This first aspect of transfer, evidenced in Gagne's position concerning a hierarchy of cumulative knowledge, is that of vertical transfer. New capabilities derive from prerequisite learning. The second aspect of transfer concerns the generalization of the concept to its use in other instances, designated as lateral transfer.

Gagne is deliberate in stating that these capabilities are not entities of verbalizable knowledge. Behaviorally they are described by what a learner can do to show evidence of mastery of that level of the hierarchy.

> Intellectual skills are learned in a short time and with extreme ease provided that the conditions are right. If the conditions are not right, however, a great deal of time can be wasted and an enormous amount of frustration generated. Most important among the right conditions is the prior learning and recall of prerequisite skills.[24]

He further states

> There should be little doubt that the mastery of basic intellectual skills is necessary for all further learning, and therefore that acquiring such skills constitutes a necessary educational goal. The most reasonable interpretation of current evidence is that systematically structured mastery in sequence is the surest way to attain this goal. To be sure, some fortunately well-endowed students find their way successfully without a pre-planned lesson structure. To imagine, however, that intellectual skills can be learned by the majority of students in an unplanned, incidental manner seems romantic wishful thinking of an extreme sort.[25]

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[24]Robert Gagne, "Expectations for School Learning," Phi Delta Kappa Address, Annual Meeting of the American Educational Research Association, New Orleans, March 1, 1973, p. 6.

[25]Ibid., p. 7.

This poses an interesting question concerning vertical learning transfer in relation to individual abilities in visual thinking. Learning processes using visual concepts have seldom been considered in art education in relation to domains of learning. To investigate sequenced learning methods with subjects of different abilities in visualization would offer data not only on the treatment effects but on visual concept learning in relation to visualizing ability.

The influence of sequenced and non-sequenced instruction upon the learning of a visual concept by subjects with differences in the visualizing ability trait poses questions under consideration in the study. Will low visualizers learn an abstract concept equally as well as high visualizers if the concept is in the visual mode and the means of measurement are also in that mode? Will the sequenced or non-sequenced presentation facilitate high or low visualizers in learning the concept?

Also the question of ability to generalize the concept for identification in art visuals is an area for investigation in the study. Will the high or low visualizing trait or the Sequenced or Non-Sequenced instructional treatment affect the generalization of the concept for use in art? Will high and low visualizers be able to abstract and apply a concept generalization in the visual learning mode equally well?

The general null hypothesis for the study states that using different instructional methods for students of different visualizing ability causes no significant difference in concept mastery or in transfer of the concept mastery to an art performance task.

Hypotheses for the Study

$H1_o$: There is no significant difference in the scores of the high visualizers and the low visualizers on the visual concept mastery test.

$H2_o$: There is no significant difference in the scores of the treatment groups on the visual concept mastery test.

$H3_o$: There is no significant difference in the scores of the high visualizers and the low visualizers on the art transfer test.

$H4_o$: There is no significant difference in the scores of the treatment groups on the art transfer test.

PROCEDURE

This study involves the design of an experiment which detects high and low visualizing children, teaches them a visual abstract concept (identifying symmetrical shapes in art designs), tests them on the concept mastery of the learning task and additionally tests the transfer value of that mastery, the identification of symmetrical shapes in works of art.

Two teaching methodologies were defined, a sequenced concept presentation and a visual trial-and-error presentation of the concept "symmetry" and instructional media (two different filmstrips) were made in order to offer the hypothesis for the experiment two means of exploration.

The concept of "symmetry" was analyzed using Gagne's hierarchy of intellectual skills to identify two prerequisite concepts of bisection and equidistance necessary for identification of shapes which are symmetrical in art visuals (Fig. 1).

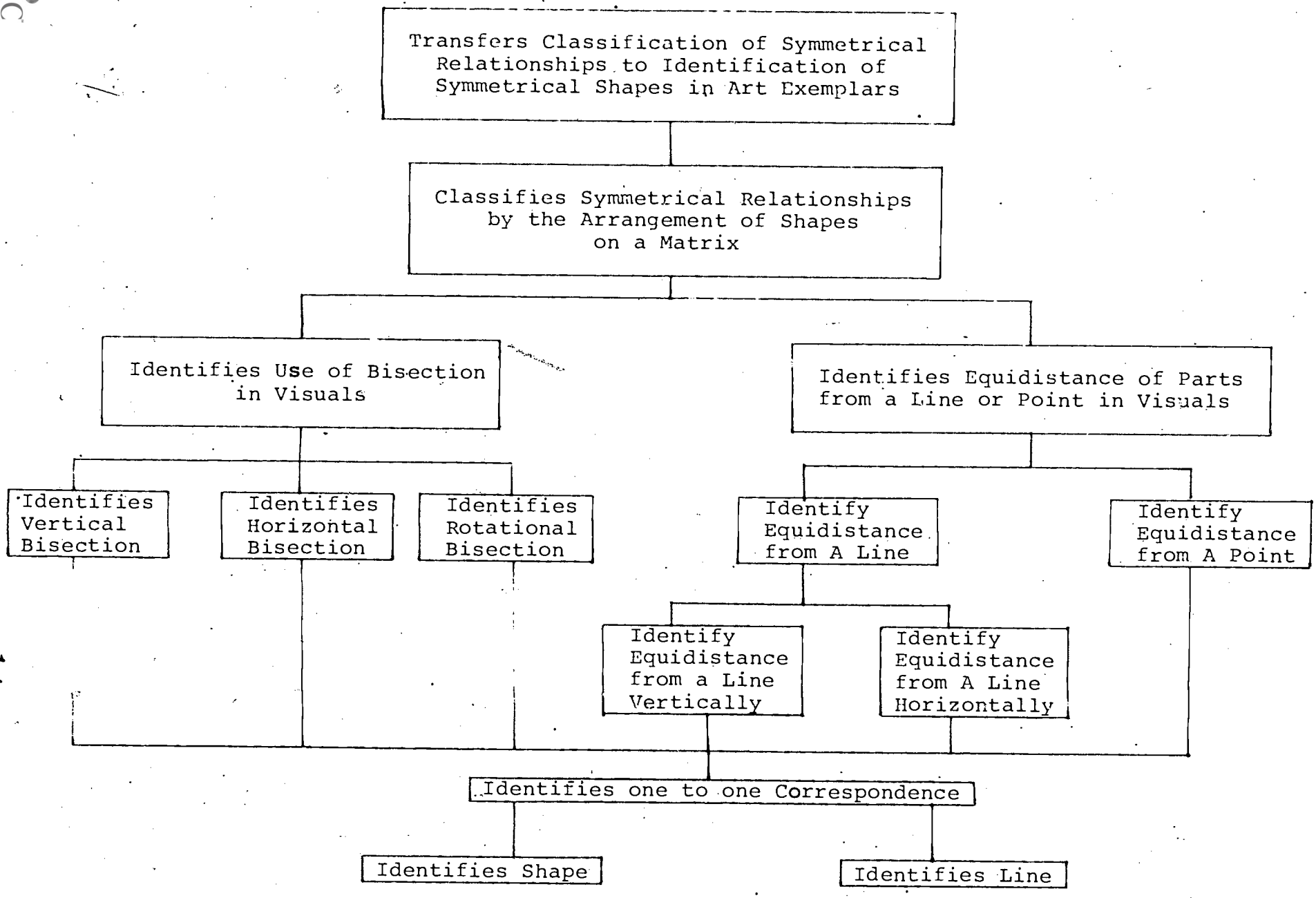

Fig. 1--Hierarchy of learning tasks for mastery of the concept of symmetry in two-dimensional visual exemplars. (Adaptation from Gagne.*)

*Robert M. Gagne, The Conditions of Learning (2nd ed.; New York: Holt, Rinehart and Winston, 1970), pp. 63-64.

A concept mastery test and an art transfer test were developed under the Briggs Model of instructional design in which three major components of instruction are interdependent:

a. specification of the instructional objective

b. development of a test measuring attainment of that objective

c. selection of media and design of instructional materials to facilitate the learning of the specific objective.

Figure 2 shows the process for the development of the materials for the experiment. One of the foremost pleas in the literature of art education by advocates of systematic curriculum evaluation is that of structuring and sequencing content in art and designing and testing instruments for measuring visual learning of the content.[26] Programs with specified learning objectives, sequenced learning tasks based on defined levels of learning, a judicious selection of media and a multiple assessment system are mandatory curriculum structures which need development in art.

The design of the experiment is illustrated in Figure 3. The selection of high and low visualizers was derived from scores which the subjects made on two tests of shape manipulation and figure

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[26] Brent Wilson, "A Proposal for Systematic Curriculum Evaluation in Art Education," Studies in Art Education, IX (Spring, 1963), 57-67; Donald Jack Davis, "Human Behavior: Its Implications for Curriculum Development in Art," Studies in Art Education, Vol. 12, No. 3, Spring, 1971, pp. 4-12.

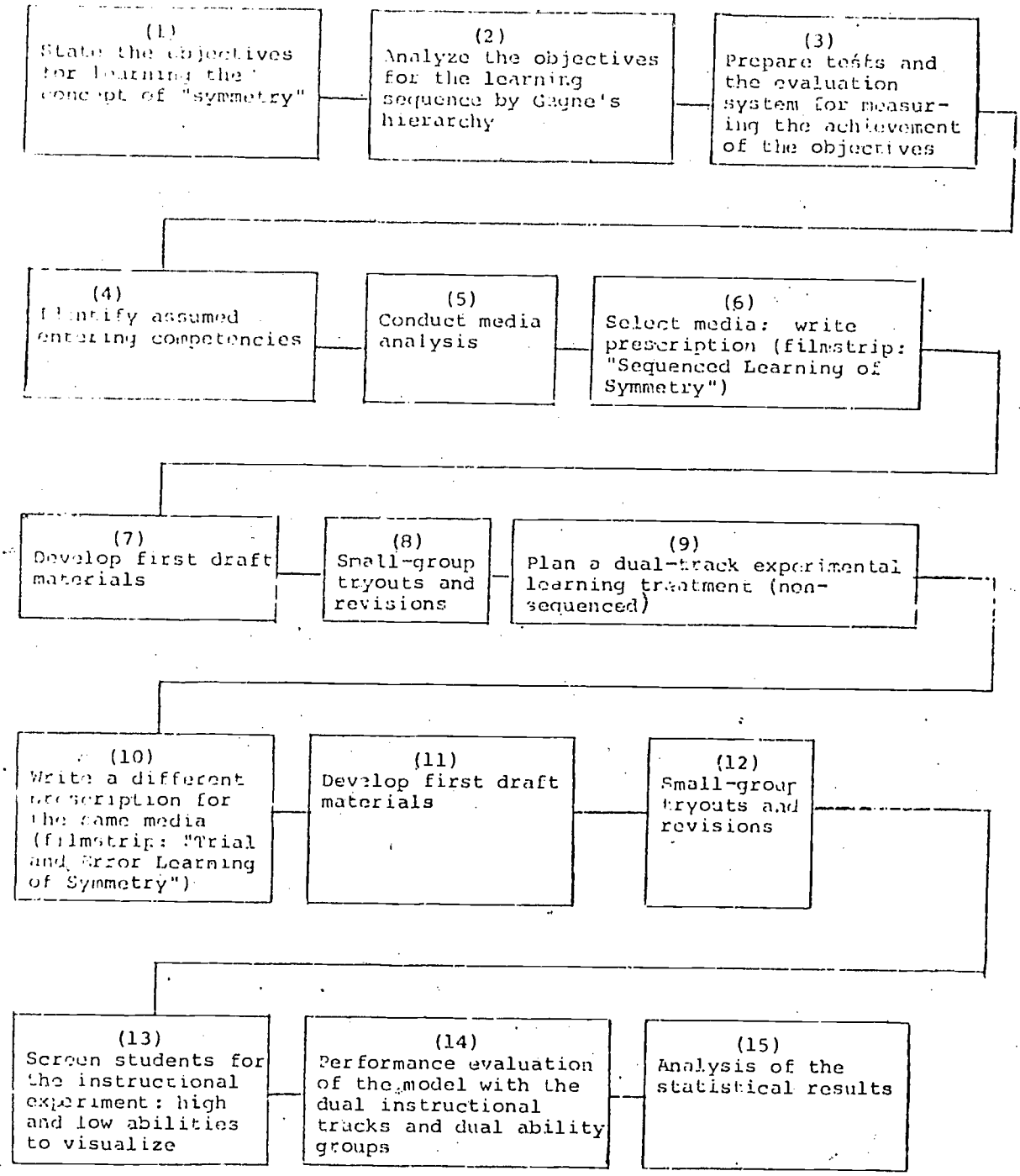
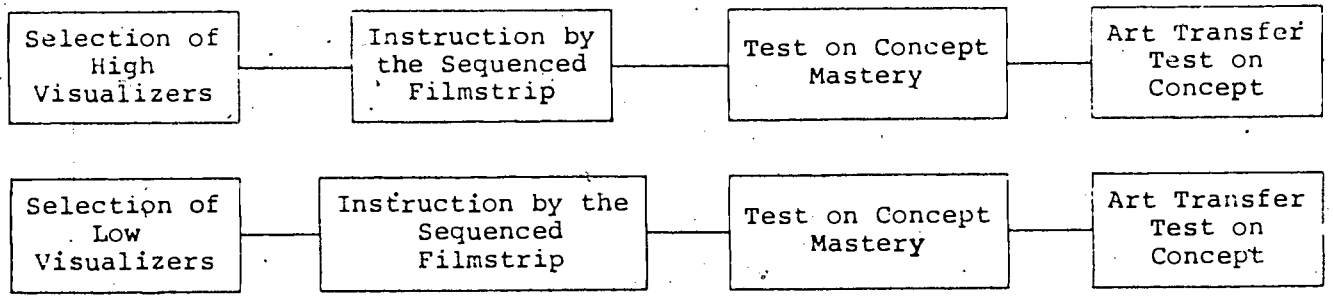
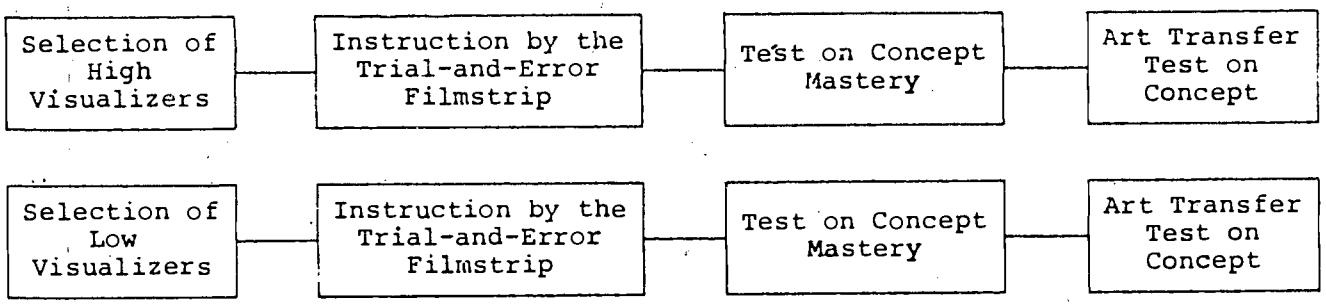


Figure 2.--Flow Chart: Design of Instruction for the Learning Module on "Symmetry". (Adaptation from the Briggs Model*)

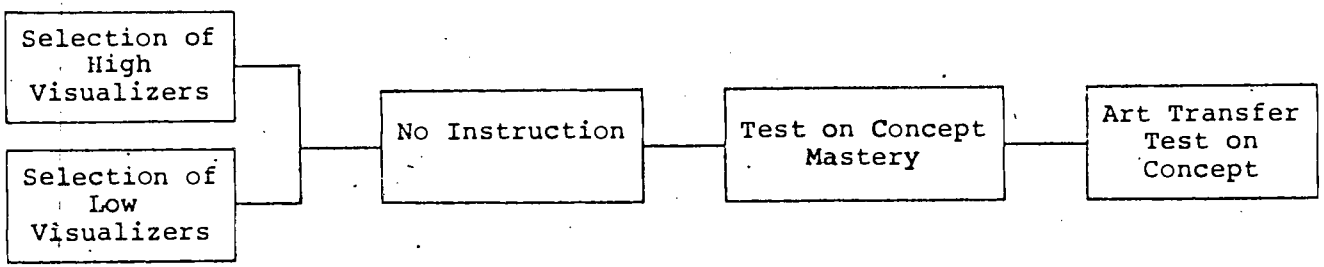
*Leslie J. Briggs, Handbook of Procedures for the Design of Instruction (Pittsburg, Pa.: American Institute of Research, 1970).



Track A—Sequenced Learning for High and Low Visualizers



Track B—Trial-and-Error Learning for High and Low Visualizers



Track C—Control Group for High and Low Visualizers

Fig. 3.--A programming outline for the experimental procedure.

transformation, the Minnesota Paper Form Board Test (MPFB)[27] and the Flags[28] test. The population from whom the subjects were chosen consisted of all fourth graders in seven schools randomly selected from all elementary schools in a county wide school system of 84,000 students, the population of the county in the second quarter of 1973 being estimated at 428,517.

These two tests were administered consecutively to all fourth grade classroom groups of students in a half-hour session per group. From scores on the tests, eighty-four high visualizers in the upper quartile of scores were selected as subjects for the experimental phase of the study. Concurrently, eighty-four low visualizers were selected from the lowest quartile of scores for the experiment. A description of the subjects is shown in tables 1 through 6.

TABLE 1. -- Sex Differentiation

	Male	Female	Total
Low Visualizers	42	42	84
High Visualizers	61	23	84

[27] W. H. Quasha and Rensis Likert, Revised Minnesota Paper Form Board Test. Manual 1970 Edition. (New York: The Psychological Corporation, 1970).

[28] L. T. Thurston and T. S. Jeffrey, Flags: A Test of Space Thinking (Chicago: Education Industry Service, 1956).

TABLE 2. -- High Visualizers and Low Visualizers by Schools

School	High Visualizers	Low Visualizers	Totals
1	27	2	29
2	8	16	24
3	7	9	16
4	12	24	36
5	3	19	22
6	15	2	17
7	12	12	24
Totals	84	84	168

TABLE 3. -- Subject's Stanine Scores from School Achievement Records*

Stanine Rank	Low Visualizers	High Visualizers
9	0	2
8	1	15
7	1	5
6	4	15
5	10	14
4	25	10
3	13	4
2	7	0
1	10	0
Totals	84	84

*CTBS:[29] Grade 3

[29]California Test Bureau, Comprehensive Test of Basic Skills (Monterey, California: McGraw-Hill Book Co., 1968).

TABLE 4. -- Mean Stanine Scores for the Experimental Groups California Test of Comprehensive Basic Skills

	M	SD	No. of Subjects
High Visualizers Control	6.17	1.72	28
High Visualizers TE	6.0	1.64	28
High Visualizers SE	5.5	1.50	26
Low Visualizers Control	3.6	1.55	28
Low Visualizers TE	3.2	1.70	28
Low Visualizers SE	3.6	1.43	27

TABLE 5. -- Mean Scores from MPFB Test* by Experimental Groups

	M	SD	No. of Subjects
High Visualizers Control	30.5	7.09	28
High Visualizers TE	30.2	6.79	28
High Visualizers SE	29.0	9.98	26
Low Visualizers Control	9.6	5.4	28
Low Visualizers TE	11.3	7.01	28
Low Visualizers SE	8.1	5.78	27

*Range 1-64.

TABLE 6. -- Mean Scores from Flags Test* by Experimental Groups

	M	SD	No. of Subjects
High Visualizers Control	58.0	13.07	28
High Visualizers TE	59.4	14.58	28
High Visualizers SE	60.9	17.46	26
Low Visualizers Control	- 5.6	7.35	28
Low Visualizers TE	- 5.6	6.88	28
Low Visualizers SE	- 4.7	4.33	27

*Range 1-126.

The fourth grade population in the seven schools contributed 629 subjects. There were 319 males and 310 females represented in the list of test scores on visualization. The mean age of the 629 students was 9.46 years.

Using the corrected raw scores recommended by each test manual, the rankings and percentiles were computerized. On the Flags test, adjusted raw scores of 1.96 and lower (through the negative scores) fell into the lower quartile of the test and adjusted raw scores of 43-98 fell into the upper quartile of the rankings of the 629 scores. On the MPFB test the adjusted raw scores of -9 to +12 served as the lower quartile ranking for the low visualizers. The high visualizers were selected from score rankings of 20-58, the upper 50th percentile. There was one quartile of scores separating the high and low visualizers in the MPFB rankings. There were two quartiles of difference in the separation of scores ranked for the high and low visualizers on the Flags test. No low visualizer had a MPFB score above the lower quartile of MPFB test scores and no high visualizer had a test score below the 50th percentile of the MPFB scores.

The scores of the two tests were not combined before percentile rankings were made because of

1. The difference in the visualization factors tested on each of the two tests;
2. The difference in number of test items and the difference in raw score adjustment formulas;
3. The relatively low correlation coefficient of .378 [Pearson Product-Moment Correlation Coefficients

for the scores on the Minnesota Paper Form Board test and the Flags test] obtained for the 629 subjects' scores on the two tests.

The high visualizers were randomly assigned to each treatment group, as were the low visualizers. An equal number of high and low visualizers were assigned to each treatment. The Sequenced learning group (SE) was given instruction by the Sequenced film on Symmetry after which the Concept Mastery test and the Art Transfer test were administered to the group. The same procedure was used with the Trial-and-Error (TE) learning group with the exception of viewing the Trial-and-Error filmstrip rather than the Sequenced filmstrip by the group. The Control group experienced the same procedures with the omission of the filmstrip viewing. The filmstrips which were used and the Concept Mastery and Art Transfer tests which were administered were those developed in the Briggs Model by the investigator. (See Fig. 2.)

The investigator worked in the school settings with each of the treatment groups within the regular scheduling of the school day. Almost an hour was needed per group to view the filmstrip and work with the testing materials. Small groups of seven or less worked with the investigator and were shown the appropriate filmstrips for that group and were administered the two tests, Concept Mastery and Art Transfer. The high and low visualizers were mixed together in the same learning groups and each came to work with the investigator with his assigned treatment group. As many as five group sessions per day were possible for the investigator to direct within school hours.

The investigator rotated the different sessions, conditions permitting, to avoid the timing of particular sessions at the same schedule slot. Thus the trial-and-error learning groups were not all held at the 9 o'clock schedule session throughout the whole experiment, but each group was administered the treatment at equally different times during the school day. The effort to avoid the artificiality of a "special event" atmosphere was sought as the investigator worked with the students in the continuity of a teacher's classroom planning. The small treatment groups worked with the researcher in private, but normally used working areas of the school such as a study room between the classroom and library or small session conference rooms. The children moved into the group as if the investigator were an additional teacher on the staff with whom they would view a filmstrip and work with some related materials. No session required more than 50 minutes of work and an hour was ample time to allow the total process of moving and resettling the next small group for the treatment session.

Directions were read and the conditions were kept as consistent as possible in every group. The testing materials were organized and administered in the same order for each session. The filmstrip viewing by each group was consistently controlled by recommended measurements of audience placement for adequate film viewing as described in Dale's publication, Audio-Visual Methods in Teaching.[30]

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[30] Edgar Dale, Audio-Visual Methods in Teaching. (Rev. ed. New York: The Dryden Press, 1954), p. 222.

RESULTS

Each of the two dependent variables, the Concept Mastery Test and the Art Transfer Test, was used separately in an ANOVA statistical design. A 2 x 3 factorial design using ability and treatment as factors was used for each test. The ability factor contained two levels of ability, high and low visualizers, and the treatment factor contained three levels of instructional treatment; Sequenced learning, Trial-and-error learning, and a Control group treatment. Program AVAR23,[31] an analysis of variance routine permitting unequal cell frequencies, was used.

Dependent Variable 1: Concept Mastery Test

A source table for an analysis of variance statistical test for Variable 1 is shown in Table 7. Data from the table indicated significance obtained ($F = 49.83$, $df = 1, 159$, $p < .01$) for the A factor, Visualization, in the experiment, the higher mean being that of the high visualizers. For this reason Hypothesis 1_o stating that there is no significant difference between scores on the concept mastery test for high and low visualizers was rejected.

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[31] D. Veldman, Fortran Programming for the Behaviorial Sciences (New York: Holt, Rinehart and Winston, Inc., 1967).

TABLE 7. -- Analysis of Variance Summary: Concept Mastery Test

Source	df	MS	F
A Vis. Ability	1	8126.26	49.83*
B Treatments	2	1387.90	8.51*
AB	2	300.11	1.84
Within Groups	159	163.06	

*$p < .01$

Data from the source table also indicated a significance obtained ($F = 8.51$, $df = 2, 159$, $p < .01$) for the B factor, Treatments. For this reason Hypothesis 2_o stating that there is no significant difference between scores on the concept mastery test of the treatment groups was rejected.

The Ability by Treatment interaction failed to obtain significance ($F = 1.84$, $df = 3, 159$, $p < .16$). A post 'hoc Neuman-Keuls sequential range test of comparative means was applied to the treatment means in the B factor. (See Table 8.)

Data from the Neuman-Keuls test showed that the Sequenced and the Trial-and-Error treatment groups each obtained significance over the Control group. The Sequenced treatment group also obtained significance over the Trial-and-Error type of treatment. (See Table 8.) Cell means for Variable 1 are shown in figures 4 and 5.

Key

--------- Low Visualizers
———————— High Visualizers

CELL MEANS: CONCEPT MASTERY TEST

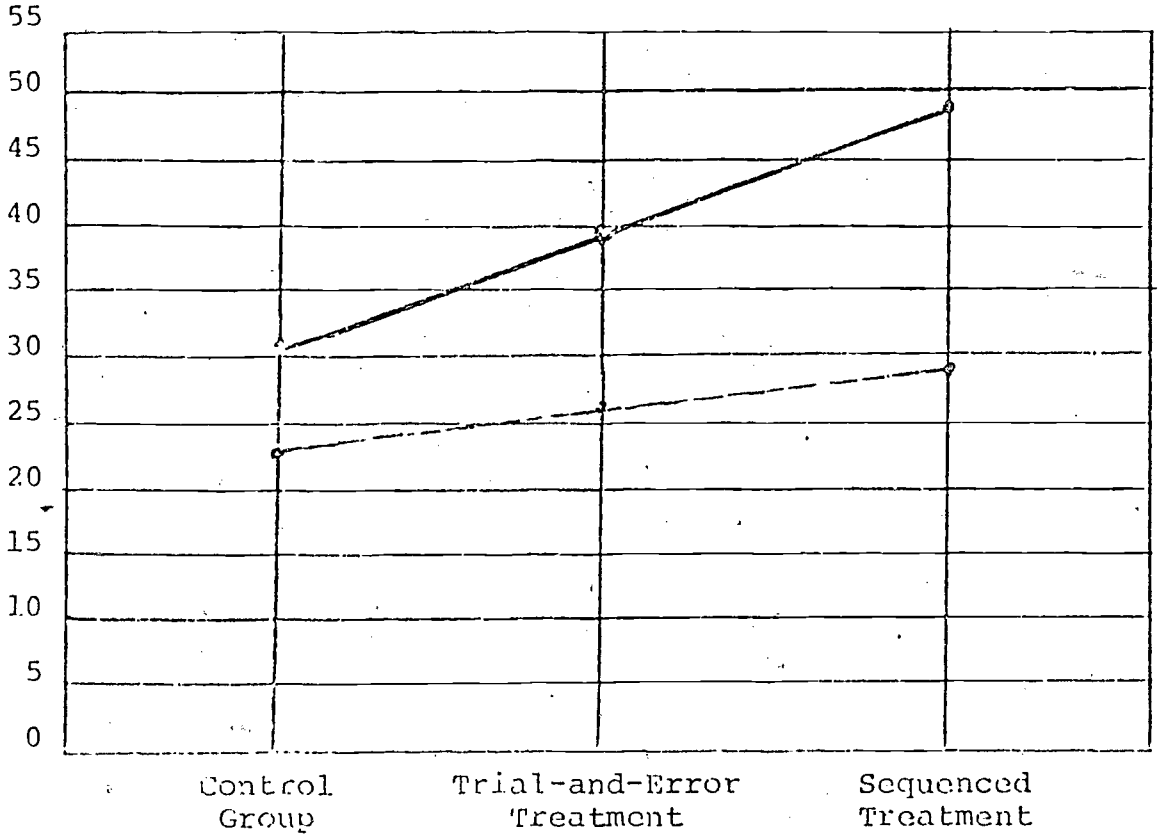

Figure 4.--Graph 1: Treatment Effect for Visualizers from Dependent Variable 1.

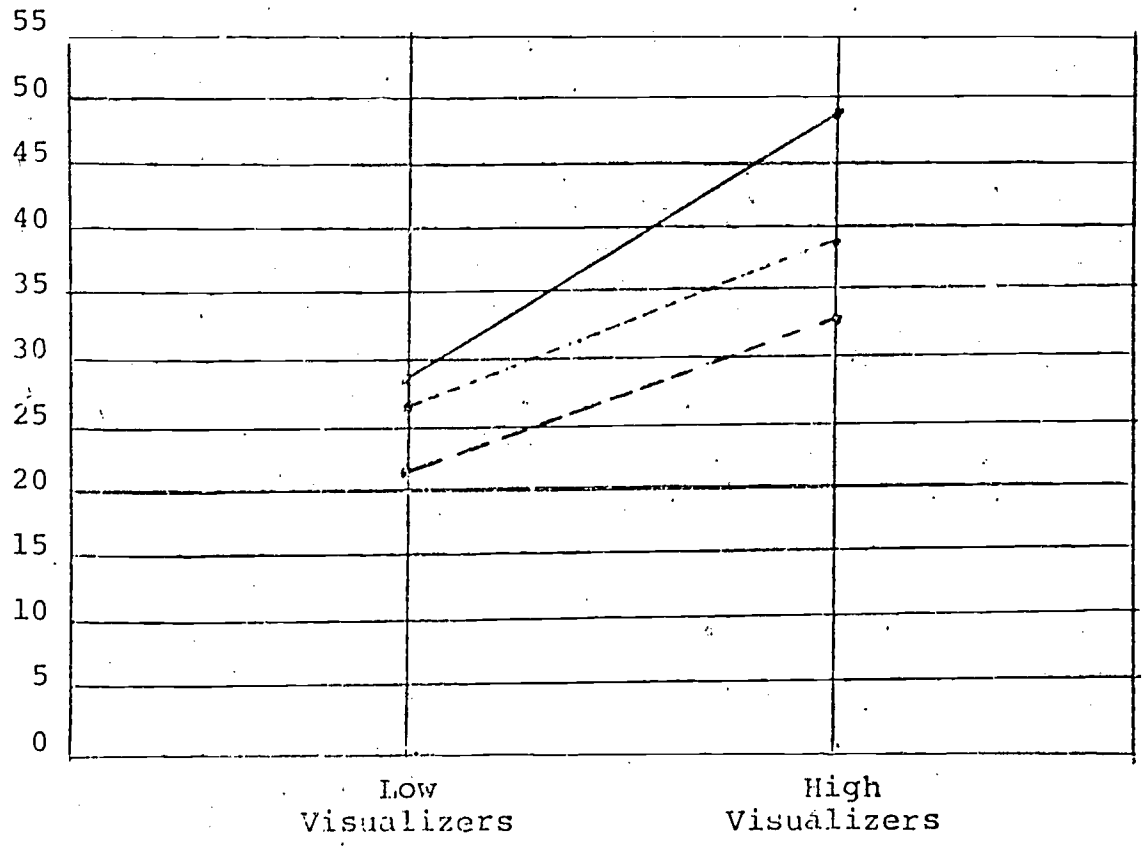

Figure 5.--Graph 2: Visualization Effect for Treatments from Dependent Variable 1.

TABLE 8. -- Newman-Keuls Test of Significance for B Factor (Treatments) Concept Mastery Test

Group Classification	Mean Difference	Contrasts
SE over Control	10.05	3.80*
SE over TE	5.18	4.83*
TE over Control	4.87	4.83*

*$p < .05$

Discussion of Variable 1

The Concept Mastery Test requested eleven concept verifications by arrangement of pairs of shapes symmetrically on matrices. Of the two levels of visualization the high visualizers made a significantly higher mean score. The group who had learned the visual concept from Sequenced methods of instruction obtained significantly higher mean scores. The Trial-and-Error group obtained a mean score significantly higher than that of the control group. The mean score of the Sequenced group was significantly higher than that of the Trial-and-Error group. From the evidence in the data it appears that sequencing the learning of the prerequisite concepts in this instance of visual learning was a definite learning advantage.

Although it might be expected that subjects with an increased degree of visualizing ability would show stronger competence in learning a visual concept, the fact that low visualizers also achieve increased competence argues for overt instruction in visual education. Additionally, it reiterates that learning visual concepts does not occur entirely by maturation but is accelerated significantly through systematized instruction.

Dependent Variable 2: Art Transfer Test

A source table for an analysis of variance statistical test for the Art Transfer Test (variable 2) appears in Table 9. Data from the source table indicated significance obtained ($F = 36.58$, $df = 1, 159$, $p < .01$) for the A factor, Visualization, in the experiment, the higher mean being that of the high visualizers. For this reason Hypothesis 3_o stating that there is no significant difference between scores on the Art Transfer test for high and low visualizers was rejected.

TABLE 9. -- Analysis of Variance Summary Table: Art Transfer Test

Source	df	MS	F
A Vis. Ability	1	11338.34	36.58*
B Treatments	2	5985.23	19.31*
AB	2	1026.12	3.31*
Within	159	309.93	

*$p < .05$

Data from the source table also indicated a significance obtained ($F = 19.31$, $df = 2, 159$, $p < .01$) for the B factor, Treatments. For this reason Hypothesis 4_o stating that there is no significant difference between scores on the Art Transfer test of the treatment groups was rejected.

The Ability by Treatment interaction was obtained ($F = 13.31$, $df = 2, 159$, $p < .01$). A Neuman-Keuls test was applied to the means of the B factor variable and revealed that the Sequenced learning transfer gained a significance over the Control group at $20.71 > 7.99$ at $p < .05$. The Trial-and-Error learning transfer gained a significance over the Control

group at $12.59 > 6.66$ at $p < .05$. The Sequenced learning gained a significance over the Trial-and-Error learning at $8.12 > 6.66$ at $p < .05$. (See Table 10.)

Data from Table 10 show an interaction effect between the A factor, visualization abilities, and the B factor, treatment groups. Further investigations were begun for applying a Neuman-Keuls test to the appropriate means.

TABLE 10. -- Neuman-Keuls Test of Significance for B Factor (Treatments): Art Transfer Test

Group Classification	Mean Difference	Contrasts
SE over Control	20.71*	7.99
SE over TE	8.12*	6.66
TE over Control	12.59*	6.66

*$p < .05$

A post 'hoc trial by trial analysis of group means using a Neuman-Keuls test of significance for the Art Transfer test was made and gave the following results. For the High Visualizers the interactions showed that the High Sequenced group obtained significance over the High Control group at $29.34 > 11.32$ and the High Trial-and-Error group obtained significance over the High Controls at $17.32 > 9.43$. The High Sequenced group also obtained significance over the High Trial-and-Error learners at $29.16 > 9.43$. (See Table 11.)

TABLE 11. -- Neuman-Keuls Test of Significance for High Visualizers: Art Transfer Test

Group	Differences Mean	Contrasts
High SE over High Control	29.34*	11.32
High TE over High Control	17.32*	9.43
High SE over High TE	29.16*	9.43

*$p < .05$

The Neuman-Keuls Test applied to the means of the Low Visualizers' scores detected no significance between the Low Trial-and-Error learners and the Control group or between the Low Sequenced learners and the Low Trial-and-Error learners. There was a significance detected between the Low Sequenced learners and the Low Control group at $12.08 > 11.32$. (See Table 12.) The interaction of all ability by treatment comparisons are listed in Table 13. Cell means for Variable 2 are shown in Figures 6 and 7.

TABLE 12. -- Neuman-Keuls Test of Significance for Low Visualizers: Art Transfer Test

Group	Mean Difference	Contrast
Low SE over Low Control	12.08*	11.32
Low SE over Low TE	4.22	9.43
Low TE over Low Control	7.85	9.43

*$p < .05$

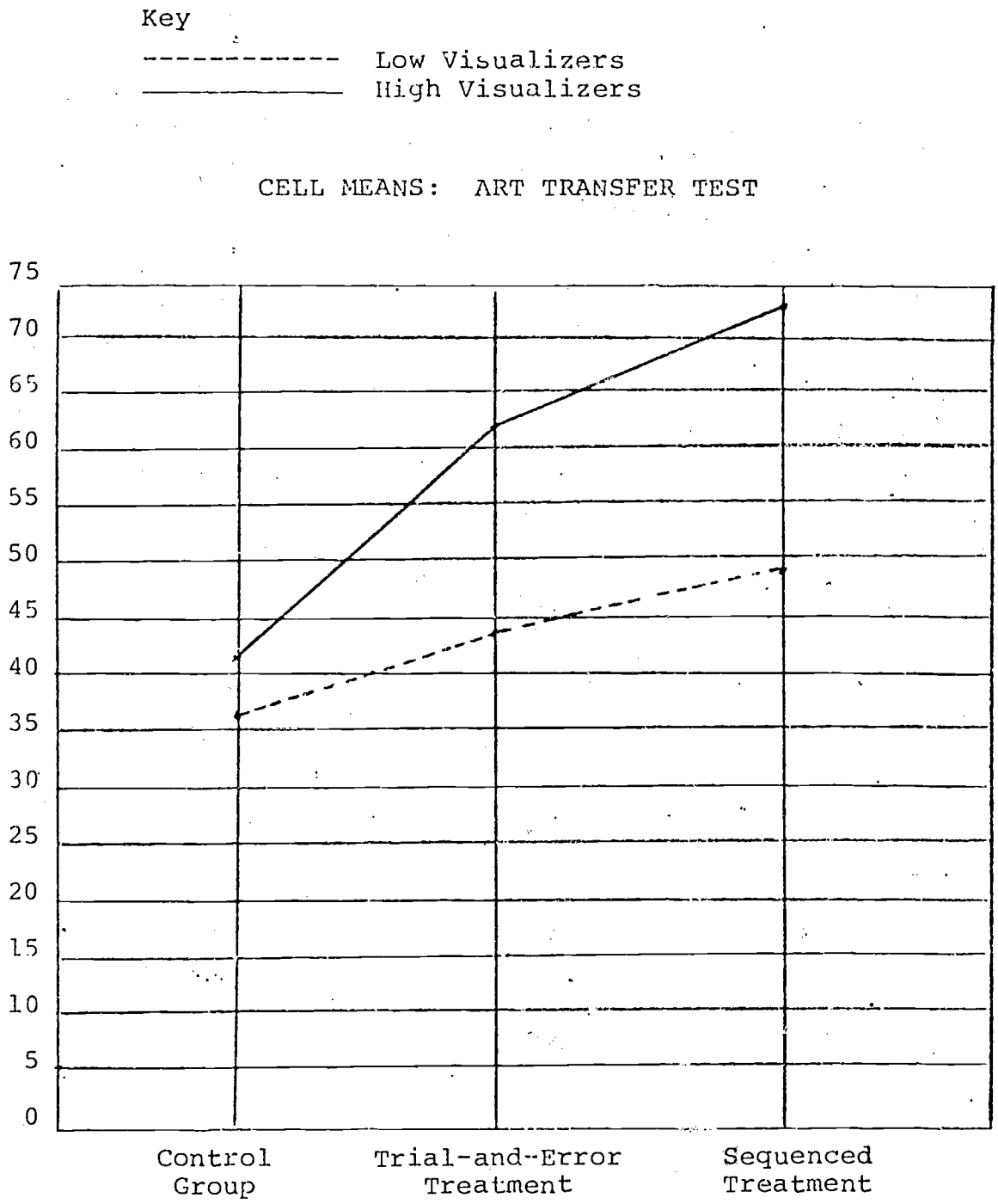

Figure 6.--Graph 3: Treatment Effect for Visualizers from Dependent Variable 2.

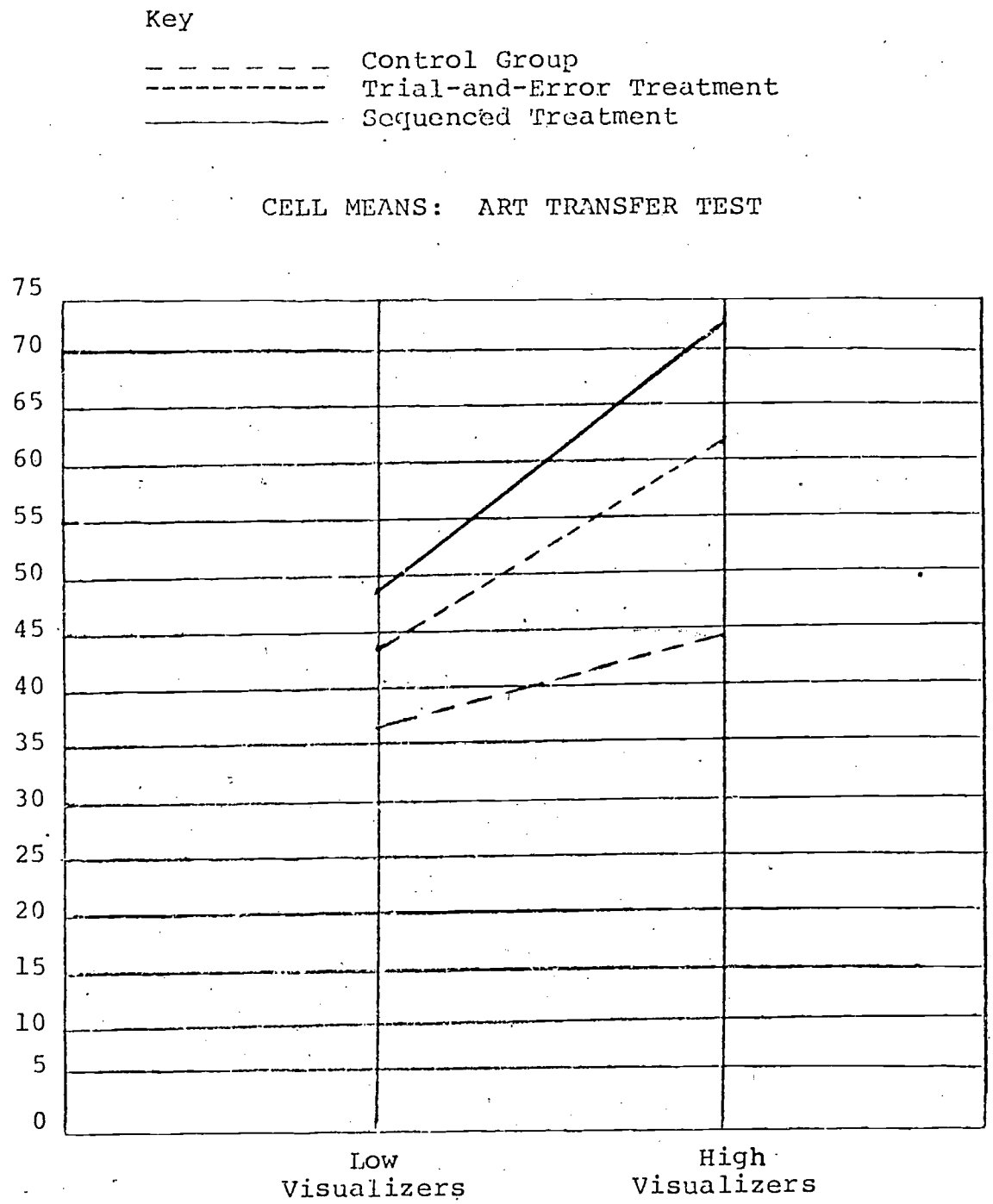

Figure 7.--Graph 4: Visualization Effect for Treatments from Dependent Variable 2.

TABLE 14. -- Newman-Keuls Test of Significance for A x B Interaction (Ability x Treatment) Art Transfer Test

Group	Mean Difference	Contrasts
H-SE over L-C	37.01	9.99*
H-SE over H-C	29.34	9.55*
H-SE over L-TE	29.16	8.99*
H-SE over L-SE	24.93	8.19*
H-SE over H-TE	12.01	6.82*
H-TE over L-C	25.00	9.55*
H-TE over H-C	17.32	8.99*
H-TE over L-TE	17.14	8.19*
H-TE over L-SE	12.92	6.82*
L-SE over L-C	12.08	8.99*
L-SE over H-C	4.40	8.19
L-SE over L-TE	4.22	6.82
L-TE over L-C	7.85	8.19
L-TE over H-C	.17	6.82
H-C over L-C	7.68	6.82*

*$p < .05$

Discussion of Variable 2

The Art Transfer Test requested twenty-two concept verifications by identification of symmetrical shapes in art exemplars. From the evidence in the data it appears that the groups receiving sequenced instruction were able to generalize the concept for application to art visuals more successfully than the TE groups, making higher mean scores on the Art Transfer test.

The high visualizers appeared more successful than low visualizers in generalizing the visual concept to art application. Stronger visualization ability seemed to aid the facility to learn a visual concept and generalize it, as supported by the significance achieved by both high treatment groups over the Control group of high visualizers.

Supporting this finding also is the fact that the visualizers in the high Control group made a significantly higher mean score than the subjects in the low Control group. Only the low Sequenced group obtained significance over the low Control group of visualizers. The Trial-and-Error learning method had minimal effect with these low visualizers and did not obtain significance.

For learning a visual concept and being able to generalize its identification to art examples the data support the use of Sequenced learning programs with the expectation that high visualizers will be more successful with the task.

CONCLUSIONS

From the data obtained in the study, the following conclusions can be summarized for the study.

1. Fourth grade students can be identified as possessing differing degrees of visualizing ability.
2. Visualizing ability in such students is strongly related to success in acquiring the concept of symmetry as it applies to visual art.
3. Both "high" and "low" visualizers can learn to improve their performance in identifying the concept, symmetry, in examples of visual art.
4. High visualizers in this study learned an abstract concept which was visual with more proficiency than did low visualizers.

5. Both "high" and "low" visualizers transfer the learning of visual concepts to use in art, with the greater degree of transfer being achieved by the high visualizers.

6. A carefully sequenced visual learning presentation of cognitive art learning reflecting an analysis of prerequisite learnings has been found to be more effective than a "trial-and-error" visual presentation of the same materials using the same medium of instruction.

The study recognized a human ability, visualizing or imagizing, which influenced art performance. The investigator attempted to control an instance of visual concept learning applicable to a real school setting and investigate the possibility that an ability trait difference could affect visual learning of the concept.

Contrary to the Kuhlman study,[32] high visualizers do learn abstract concepts as well as or better than low visualizers as data shows in this study which uses abstract visual concepts. An art educator who constantly examines visual evidences of abstract thought might make judgments concerning abstract concept learning from a different point of view from those educators who work with abstraction in the verbal learning mode.

To assume that abstract thought reaches maximum complexity through use with the verbal symbol system exclusively may define human functioning

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[32] Kuhlman, op. cit., p. 1005.

too grossly and extinguish opportunities for research into a human facility which is equal to or greater than other modal systems of communication. Data establishing an ability trait difference in learning a visual art concept suggest the need to further investigate the trait as used in discrimination learning and concept learning in art.

Dr. Rowe is on the faculty of the Art Department at the University of North Carolina at Greensboro. The experiment was conducted as her dissertation work for the Department of Art Education and Constructive Design, College of Visual Arts, the Florida State University, Tallahassee.