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ABSTRACT

To determine the effects of the amount and type of information supplied by a concept definition, fourth and eighth graders were presented with one of two definitions: a "technical" definition which precisely specified all defining attributes of the concept, and a "common usage" definition from a children's dictionary which did not specify all defining attributes. Fourth graders were found to perform significantly better on a classification task with the common usage definition than with the technical definition, while eighth graders performed better with the technical than the common usage. It was concluded that for younger students it is more important to provide a definition written at an appropriate level than a definition which completely specifies the concept's defining attributes. (Author)

Technical Report No. 261

THE EFFECTS OF TWO KINDS OF DEFINITION ON THE CONCEPT ATTAINMENT OF FOURTH- AND EIGHTH-GRADE STUDENTS

by

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Report from the Research Component
Conditions of School Learning and Instructional Strategies

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Statement of Focus

Individually Guided Education (IGE) is a new comprehensive system of elementary education. The following components of the IGE system are in varying stages of development and implementation: a new organization for instruction and related administrative arrangements; a model of instructional programing for the individual student; and curriculum components in prereading, reading, mathematics, motivation, and environmental education. The development of other curriculum components, of a system for managing instruction by computer, and of instructional strategies is needed to complete the system. Continuing programmatic research is required to provide a sound knowledge base for the components under development and for improved second generation components. Finally, systematic implementation is essential so that the products will function properly in the IGE schools.

The Center plans and carries out the research, development, and implementation components of its IGE program in this sequence: (1) identify the needs and delimit the component problem area; (2) assess the possible constraints—financial resources and availability of staff; (3) formulate general plans and specific procedures for solving the problems; (4) secure and allocate human and material resources to carry out the plans; (5) provide for effective communication among personnel and efficient management of activities and resources; and (6) evaluate the effectiveness of each activity and its contribution to the total program and correct any difficulties through feedback mechanisms and appropriate management techniques.

A self-renewing system of elementary education is projected in each participating elementary school, i.e., one which is less dependent on external sources for direction and is more responsive to the needs of the children attending each particular school. In the IGE schools, Center-developed and other curriculum products compatible with the Center's instructional programing model will lead to higher student achievement and self-direction in learning and in conduct and also to higher morale and job satisfaction among educational personnel. Each developmental product makes its unique contribution to IGE as it is implemented in the schools. The various research components add to the knowledge of Center practitioners, developers, and theorists.

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Abstract

To determine the effect of the amount and type of information supplied by a concept definition, fourth and eighth graders were presented with one of two definitions: a "technical" definition which precisely specified all defining attributes of the concept, and a "common usage" definition from a children's dictionary which did not specify all defining attributes. Fourth graders were found to perform significantly better on a classification task with the common usage definition than with the technical definition, while eighth graders performed better with the technical than the common usage. It was concluded that for younger students it is more important to provide a definition written at an appropriate level than a definition which completely specifies the concept's defining attributes.

I
Introduction

Three sets of variables are related to the level of concept mastery attained by individuals: variables associated with the learner, variables associated with the instructional situation, and variables associated with the concept itself (Klausmeier, Ghatala, & Frayer, in press). Variables related to the learner include the prior experiences of the learner as represented by age, the level of conceptual development as related to a particular concept, and cognitive style. Variables associated with the instructional situation include the presence or absence of a concept definition, the number and sequencing of examples and nonexamples, and the presence or absence of cues which point to defining (major relevant) attributes. Variables related to the concept itself include the number of defining and irrelevant attributes associated with the concept, the kind of rule joining the defining attributes, and the extent to which the concept does or does not have readily perceivable examples or representations of examples such as can be constructed with line drawings. Of particular interest in the present study were variables related to the learner and to the definition of the concept given the learner.

Presenting a concept definition has been empirically demonstrated to facilitate learning under a variety of conditions. Both Johnson and Stratton (1966) and Anderson and Kulhavy (1972) found that a high level of concept attainment can result from merely giving a concept definition alone. Merrill and Tennyson (1971) reported that a definition used in conjunction with concept examples and nonexamples was more effective than either the examples and nonexamples alone or the definition alone. Additionally, Feldman (1972), Swanson (1972), and Frayer (1970) found that presenting a concept definition reduced the effect of increasing the number of examples and nonexamples that were presented with the definition.

Providing a concept definition, however, has not been shown to facilitate concept attainment under all instructional conditions. Markle and Tiemann (1972) reported that one-fourth of a group of college students were unable to correctly classify even half of a pool of unlabeled concept examples and nonexamples after being given a standard dictionary definition or three modifications of that definition. Swanson (1972) found that his subjects actually performed better when given only examples and nonexamples of a concept than when given examples and nonexamples with a definition.

The effectiveness of a given concept definition in promoting learning is undoubtedly dependent upon the presence or absence of all variables which operate to influence attainment. Markle and Tiemann (1972) have demonstrated that even the type of definition used in a teaching sequence can be a critical factor. They found that subjects (college students) provided with a concept definition which specified all of the defining attributes of a concept performed better on both a generalization and a discrimination task than subjects provided with a definition which did not specify all of the defining attributes.

Even the most complete definition, however, is likely to be ineffectual if it is too long or too difficult to be understood by the learner. For young students it may be more important to provide a definition written at an appropriate level of comprehensibility than to provide a definition which includes all the relevant attributes of the concept. However, no empirical investigations have been conducted specifically to ascertain the relationship between the level or kind of vocabulary used in a definition and the prior experience of the learner as represented by grade level in school.

The purpose of the present study was to determine the relative effectiveness of definitions which varied in completeness and difficulty of vocabulary. Two types of defi-

nitions were used at two grade levels, fourth and eighth. One definition was stated in "technical" terms and specified each of the defining attributes of the concept. The other definition was stated in nontechnical, "common usage" language and did not include all of the defining attributes. It was predicted that eighth-grade students would perform better than fourth-grade students on a classification task regardless of the type of definition read. However, it was also expected that fourth graders would perform better with the common usage definition than the technical definition while eighth graders would perform better with the technical than the common usage definition. The latter prediction was based on the assumption that the younger subjects would not be able to comprehend the technical definition as fully as they would the common usage definition, while the older subjects would be able to comprehend the two definitions equally well and would effectively use the additional information supplied by the technical definition on the classification task.

II
Method

Subjects

Subjects were 59 fourth graders and 60 eighth graders enrolled in two elementary schools and one junior high school in a small midwestern city. At each grade level two classrooms that were considered typical for the city participated in the study. Average IQ scores (Lorge Thorndike) were 109.1 for the fourth graders and 110.6 for the eighth graders. Subjects were assigned at random to treatment conditions (common usage or technical definition) and tested in classroom groups.

Materials

The experimental concept used in the study was *equilateral triangle*. This concept has eight relevant attributes. It is (1) plane, (2) closed, and (3) simple with (4) three (5) straight sides of (6) equal length and (7) three (8) equal angles. Attributes 7 and 8 supply redundant information when attributes 1-6 are given. Attributes 1-6, therefore, were considered the defining (major relevant) attributes.

Two definitions of equilateral triangle were developed, one labeled a "technical" definition and the other a "common usage" definition. The technical definition specified each of the defining attributes of the concept (1-6). No attempt was made to explain what was meant by plane, closed, or simple, and no irrelevant attributes or examples of the concept were given. The technical definition was: An equilateral triangle is a figure with three straight sides of equal length. It is plane, closed, and simple.

The common usage definition was derived from the definitions of equilateral and triangle found in *Webster's New World Dictionary: Elementary Edition* (1966). These definitions were: equilateral—"having all sides equal in length"; and triangle—"a flat figure with three sides and three angles." In constructing the common usage definition it was decided not to use the words "three angles" so that attributes not included in the technical definition would not be introduced in the common usage definition. The word "flat" was also deleted as it was felt that the idea of a flat figure might not be clear to fourth graders. The final derived definition was: An equilateral triangle is a figure with three sides which are all equal in length. Two of the six defining attributes of the concept are specified by the definition. Again, no irrelevant attributes or examples were given.

The common usage definition was considered to be written at a level appropriate for fourth-grade students who had no prior knowledge of the concept. Both the technical and the common usage definitions were reviewed and judged appropriate and accurate by an expert in elementary mathematics education.

A group of 24 drawings of equilateral triangles (examples) and 26 drawings of geometric figures other than equilateral triangles (nonexamples) were selected to assess concept attainment. The examples varied along three irrelevant dimensions: size (small, medium, or large), solid or line drawing, and orientation. The nonexamples were constructed so that each possessed all but one or two of the major relevant attributes. The nonexamples varied along the same irrelevant dimensions as the examples. All examples and nonexamples were planar to avoid possible difficulties in accurately perceiving three-dimensional figures on a two-dimensional page. Representative examples of the figures used are presented in Figure 1.

Two forms of a printed self-instructional booklet were developed to present the concept definitions and the examples and non-

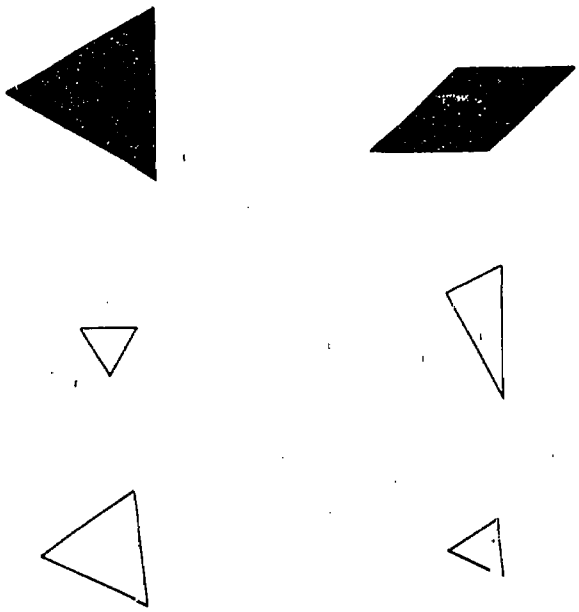

Figure 1.—Representative examples of the equilateral triangles (examples) and general geometric figures (nonexamples) used to assess concept attainment.

examples. One form contained the technical definition and the other the common usage definition. Approximately one-half of the subjects received each form.

Each instructional booklet consisted of: (1) a numbered list of the words used in the booklet which the authors felt might be unfamiliar to the subjects, (2) a sample item dealing with the concept "butterfly," (3) one of the two concept definitions, and (4) the examples and nonexamples. The word list and sample item appeared on the first two pages. The definition was presented in a box at the top of the third page and was immediately followed by the examples and nonexamples. Beneath each example and nonexample were printed the words "yes" and "no."

The format for the sample item was identical to that for the experimental concept. A definition of butterfly was presented in a box at the top of the page followed by a group of figures which were either examples or nonexamples of the concept. The words "yes" and "no" were printed below each figure.

Procedure

The subject's task was to read the definition of equilateral triangle given in his instructional booklet and on the basis of the definition to decide which of the figures following it were examples of the concept and which were not. Directions presented with the definition instructed subjects to read the definition and circle the word "yes" beneath each figure which they thought was an example of the concept and to circle the word "no" beneath each figure which they thought was not an example. Directions included with the sample item were identical.

At the start of the testing session the experimenter reviewed the word list. For each word the experimenter asked, "Do you see the word _____ listed here?" After several subjects indicated that they saw the word the experimenter said, "What number is it?" The experimenter waited until most subjects had located the word and then called on one subject to give the number of the word. The experimenter and subjects then pronounced the word together. This procedure was designed to ensure that subjects could read all of the words in the booklets.

The experimenter next discussed the sample page. The instructions were read aloud and subjects were directed to circle the correct responses. After all subjects were finished, the experimenter indicated the correct answers. Subjects were then instructed to turn the page and begin work independently on the experimental concept. Neither the directions for the experimental concept nor the concept definitions were read aloud, and no attempt was made to define the attributes mentioned in the definitions.

Subjects were allowed to work on their booklets for as long as they wished. While they were working the experimenter answered only questions dealing with instructions and the pronunciation of words.

III
Results

Fourth graders scored lower than eighth graders on the classification task regardless of the type of definition read. Means were 43.33 for fourth graders and 46.97 for eighth graders given the technical definition, and 45.52 for fourth graders and 46.23 for eighth graders given the common usage definition. As expected, however, the younger subjects performed better with the common usage definition than they did with the technical definition, while the older subjects performed better with the technical definition than they did with the common usage. Mean scores according to grade level of subject and kind of definition are given in Table 1.

A 2 x 2 analysis of variance was carried out on the data presented in Table 1. A significant main effect was found for grade level ($p < .01$) but not for type of definition. Thus the difference between overall scores for fourth and eighth graders was statistically significant. The interaction between grade level and definition was also significant at the .07 level. The interaction was due to the fact that fourth graders performed better with the common usage definition than the technical definition while eighth graders performed better with the technical definition than the common usage. The results of this analysis are summarized in Table 2.

Table 1. Means and Standard Deviations According to Technical and Common Usage Definitions and Grade Levels Four and Eight.

Grade Level	Technical Definition			Common Usage Definition			Mean
	n	mean	SD	n	mean	SD	
4	30	43.33	6.44	29	45.52	3.97	44.41
8	30	46.97	3.45	30	46.23	3.00	46.60
Mean		45.15			45.88		

Table 2. Least Squares Analysis of Variance Summary Table.

Source	*df*	*MS*	*F*	*p* <
A (Kind of Definition)	1	15.9120	.7989	ns
B (Grade Level)	1	143.0956	7.1826	.01
A x B	1	62.4239	3.2312	.07
Error	115	19.9226		

In order to interpret more precisely the results of the interaction, *post hoc* comparisons among the cell means were carried out using Tukey's procedure. Fourth graders given the common usage definition were found to perform significantly better than fourth graders given the technical definition ($p < .01$), while the difference in scores for the eighth graders on the two definitions was not significant. Additionally, eighth graders given the technical definition scored significantly higher ($p < .01$) than fourth graders given the technical definition, although there was no difference in performance between grades on the common usage definition.

IV
Discussion

The results of the experiment supported both hypotheses. Eighth graders were able to identify significantly more examples and nonexamples of the concept than fourth graders on the basis of the definitions provided. More importantly, however, fourth graders performed significantly better with the common usage definition than with the technical definition while eighth graders performed slightly better with the technical definition than with the common usage. Apparently, the more precise information provided in the technical definition was not understood by the fourth graders and, therefore, was not helpful in identifying examples and nonexamples. The eighth graders, however, appear to have been able to understand the technical definition and to use the additional information it provided, although the increase in performance for eighth graders from common usage definition to technical definition was not significant.

That fourth graders performed better with an "incomplete" definition written at their level than a complete definition written at a technical level adds a qualification to Markle and Tiemann's (1972) finding that the most effective definition is one which specifies all of the concept's defining attributes. Apparently, the more important variable for younger children is the comprehensibility of the definition rather than its completeness and technical accuracy. This implies that if particular attributes of a concept cannot be stated in a way which is understandable to the learner it is better not to include them when defining the concept.

It might reasonably be questioned whether the results of this experiment would be obtained with other concepts and with children at other grade levels. It is probable that the same results would hold with other concepts that can be defined in terms of attributes at two distinct levels—the common usage level which is ordinarily given in dictionaries, and the technical level which is used by subject matter experts. The extent to which the same results would be found with various age groups, however, appears to be directly related to the ability of the particular age group to comprehend the definitions. Young children of age three to five might not even understand the common usage definition and, therefore, with this group no difference between the common usage and technical definition might be found. Conversely, students at the high school level might comprehend the technical definition more fully than the eighth graders in the present study and consequently perform significantly better with a technical definition than a common usage one.

The results of this study, however, must be interpreted in the context of the amount and type of information given subjects about the concept. Only information from a verbal definition was provided. No attempt was made to teach subjects the concept by providing such things as examples and nonexamples or by emphasizing defining attributes. Similarly, no attempt was made to help subjects comprehend the definition. The effect of a particular definition in any given situation is presumed to be dependent upon the amount of additional information about the concept which is available to the learner from various sources. Undoubtedly, the more information about the concept the learner is given from other sources, the less important the particular type of definition presented becomes.

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