DOCUMENT RESUME

ED 023 467 PS 001 270

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Child Development and Social Science Education. Part IV: A Teaching Strategy Derived From Some Piagetian Concepts.

Merrill Palmer Inst., Detroit, Mich.
Spons Agency-Office of Education (DHEW), Washington, D.C.
Pub Date Mar 66
Note-24p.
EDRS Price MF-$0.25 HC-$1.30
Descriptors-Classification, *Cognitive Development, Conservation (Concept), *Curriculum Development, *Educational Strategies, Logical Thinking, *Social Sciences, *Teaching Methods, Theories
Identifiers-*Piaget

In this fourth part of a study of the relevance of existing knowledge about child development to social science curriculum development, some tentative suggestions are made for incorporating some of the fundamental ideas of Piaget into a teaching strategy. The ability of children to deal with classifications on the basis of single discrete attributes and their later ability to make multiple classifications and relationships are discussed. Reversibility and reciprocity, as intellectual operations which are necessary prior to multiple classification and conservation understanding are also discussed. (MS)

CHILD DEVELOPMENT AND
SOCIAL SCIENCE EDUCATION.

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SOME PIAGETIAN CONCEPTS

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Publication #113 of the
Social Science Education Consortium

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The research reported herein was performed pursuant to a contract with the United States Department of Health, Education and Welfare, Office of Education, under the provisions of the Cooperative Research Program.

FOREWORD

This publication is Part IV of a four-part report on a study of the relevance of existing knowledge about child development to social science curriculum development. The study, directed by Dr. Irving Sigel, of the Merrill-Palmer Institute of Human Development and Family Life, was supported in part by a developmental contract of the United States Office of Education, made with Purdue University for the Social Science Education Consortium, and in part by a grant from the National Institute of Mental Health.

Part I describes the problem of inadequate communication between developmental psychologists and curriculum workers, and suggests some directions for cooperative efforts between the two groups. Part II reports on a test run of such a cooperative effort, in which developmental psychologists applied the findings of their profession to specific problems posed by social science educators. Part III consists of 67 abstracts of child development source materials which the Merrill-Palmer group felt are most relevant to the problems of constructing sound social studies curricula. This report, Part IV, makes some tentative suggestions for incorporating some of the fundamental ideas of Piaget into a teaching strategy.

Dr. Sigel wishes to acknowledge the help of Frank Hooper, Frederick Stevens, and James Bruce, who helped carry out the Piagetian classification experiments described herein.

Irving Morrissett

March 1966

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CHILD DEVELOPMENT AND SOCIAL SCIENCE EDUCATION
PART IV: A TEACHING STRATEGY DERIVED FROM SOME PIAGETIAN CONCEPTS

Irving E. Sigel
The Merrill-Palmer Institute

Introduction

In a previous report to the Consortium (Sigel, 1966), a number of Piagetian concepts were described as relevant to curriculum development in the social sciences. In that report the development of a number of intellectual characteristics of children were identified and it was shown how these could be taken into account when planning curricula. The basic assumption in that report was that intellectual development is sequential, orderly and irreversible. Specific characteristics of elementary school children were identified and their changes with increased maturity were described. For example, it was pointed out that elementary school children in the early grades tend to take things more literally than they do at a later age. This suggests that care must be taken in presenting material to young children--in kindergarten and first grade--so that their predilection for literalness does not get in the way of their learning. A number of other characteristics which were considered, such as the ability to formulate hypotheses, the ability to handle contradictions, the ability to make inferences, and the ability to make logical classifications, were all felt to have relevance for curriculum construction. Since each of these was described in some detail, there is no need to elaborate them here.

The important issue to be pursued further in this report is a crucial element of Piagetian theory, namely, the ability of children to deal with classifications, to create classes, to break down classes into subclasses, and to reorganize classes on alternate bases. In effect, the entire process of classification will be the focus of this paper, with the hope that discussion of this matter will point to direct applications for the classroom.

We shall not go into Piagetian theory in great detail. We will be concerned here with the period referred to as "concrete operations," which is the period covering roughly ages four to five through eight to nine, that is, kindergarten through about fourth grade; but these chronological ages should not be taken literally. A detailed discussion summarizing Piaget's description of this period can be found in Flavell, 1963.

The Importance of Classes in Logical Thought

According to Piaget, one of the cornerstones of logical thought is the ability of the thinker to think in class terms, e.g., classes such as animals, vehicles, and natural phenomena. During the elementary period considered here children acquire the competency to add classes together, to multiply classes, to divide classes into smaller units, to expand classes, and to think in terms of classes of items which are bigger than or less than others. We shall have occasion to discuss these in great detail.

When we think of class labels, we tend to think in such common terms as animals or vehicles, or men or women. However, items can be classified on many other criteria, such as size, shape, color, texture, function, locale, material. Every object, event, or person is polydimensional and hence possesses many characteristics which we shall refer to as attributes. Instances (which is a term we will use to refer to items, persons, or events) can be classified on the basis of one or more of their attributes. Therefore, it can be argued that instances are not fixed members of a single class, but can be items in various classes depending upon the particular attribute that is selected as a criterion for class membership.

The awareness that items have many dimensions is a necessary first step in the acquisition of the knowledge that class membership is relative. Classes, then, are formed and reformed on the basis of single attributes. Later children learn to build classes on the basis of two or more attributes. This is what we will refer to as multiple classification. For example, objects can be classified on the basis of size and texture, or size and function, or function and locale, or any other combination of two or more attributes. The ability to use two discrete attributes simultaneously as the basis for classification is a difficult process and one that children customarily are not able to do until the fourth grade. It is this phenomenon that is the focus of this paper.

The "Natural" Pace of Cognitive Growth

Let us begin by disavowing assumptions about the "natural" course of intellectual thought. This matter is mentioned here because subsequently much of what will be discussed will appear to be, or can be interpreted to be, accelerative or pushing. We must remember that what we know about the development of children's thinking comes from observations of their thought activities in our particular culture. What some might consider "natural" is really a product of children living in a particular kind of intellectual, social, and psychological environment. The ages at which particular thought processes emerge must be construed as products of particular cultural experiences, rather than as "natural." The kind of environment that children live in, such as lower or middle class, plays an important role in determining certain trends in the development of thinking. Whether these trends would be present if the environments were modified is an open question. Cross-cultural studies do show that certain intellectual competencies in the course of cognitive growth vary, depending upon the kind of symbolic environment the child experiences. Apparently the rate at which the child moves from one period to another is, in part, a function of the environment. We should not be beguiled into dubious age criteria or assumptions about "naturalness."

The reader should not construe the proposals in this report as arguments either for acceleration or for holding back. These terms are value-laden and based on the assumption that we know for certain what the course of cognitive growth is in relation to specific ages. The argument that six-year-old children think in concrete terms--that they are unable to think in abstract terms or to make hypotheses--is based on our knowledge of six-year-old children who have grown up in our particular kind of environment. We do not know what would happen if environments were modified and training procedures in logical thinking begun in nursery schools. It may well be that, starting this way, the children in later grades would show entirely different patterns of thinking.

The Sequence of Cognitive Growth

Then what are we to assume? Let us first assume that there may be a course of cognitive growth which follows a sequential order, and that this order is determined by the tasks that are to be accomplished, where certain previous requirements are necessary for subsequent activities to occur. This seems to be true from what we know about task requirements in general. For example, one cannot learn subtraction or multiplication until one has learned the concept of number. One also has to learn to add before one can learn other arithmetic processes. In many fields of study, as well as in logical thought itself, the assumption is that certain prerequisites are necessary for subsequent competencies to appear. Subject matters have their inherent logical order. The ability of the child to handle particular kinds of tasks depends on prerequisite experiences and competencies. Performance at each level is related to past experiences and previous competencies, integrated into current abilities, and sets the stage for subsequent experiences. We should assess the child in terms of where he is in relation to particular kinds of tasks.

Piagetian theory holds that intellect develops in invariant sequential order and that the child must proceed through each step in order to achieve the type of logical thinking usually associated with adults. Adult thinking is logical where the adult is capable of hypothesis formation, has the ability to handle symbolic material, and has the ability to deal with representations. The adult is capable of performing certain kinds of mental operations, such as addition, subtraction, and multiplication. He does not need to act out particular kinds of ideas, or to see them demonstrated; he can use symbolic materials to demonstrate or understand particular operations. Thus, when the adult sees a plus sign or a division sign, the sign tells him what actions to take mentally in a particular problem.

The acquisition of these competencies in the use of symbolic materials comes about through a long and arduous course of development. The child has to learn how to perform certain mental operations, how to disengage himself from the environment and to think abstractly. He has to learn to think in an "as if" way; that is, a hypothetical, deductive way. He also has to learn how to solve problems by induction. The acquisition of these skills, it is argued in Piagetian theory, comes about through a series of stages from infancy through adolescence, in which the child progresses in irreversible order toward mature adult-like thought. (For summaries of this theory see Sigel, 1964; Flavell, 1963; Peel, 1960.)

The theory is complex and involves many more details than can be elucidated in this report. Central to the entire point of view is the argument that the ability to think in logical terms has as one of its crucial prerequisites the ability to deal in multiple classifications and multiple relations, and to add, subtract, and divide classes. Let us discuss the development of this particular phenomenon and show how it can contribute to social science teaching, particularly by providing a teaching strategy.

Classification Behavior: Class Labeling

Let us begin at the most elemental point and take any object--an apple, a pear, ice cream, whatever we wish. Stop for a moment and think about this object. The apple has many attributes. It has size. It has a particular texture. It has a skin, a stem. It grows on a tree. It has curved surfaces. It has color. It has utility. It has taste. It has many functions ranging from eating to throwing. Each of these attributes is an accurate designation of part of this thing we call "apple." The pear and the ice cream can be discussed in the same way, each possessing similar as well as diverse attributes. Each object possesses a myriad of attributes denoting various aspects of its structure of function. Too often we become unaware of these complexities because we tend to focus on an apple in its primary function as something to eat, or something red. The same thing is true with most objects. We establish a particular relationship with the object, are aware of its primary role; too often we continue to think of it in these limited terms.

Such an attitude toward complex objects is very economical, in that it facilitates our establishing appropriate behaviors and attitudes toward the objects; but it is also a limitation. We develop a schema of "apple" by which actions and meanings are organized. When reading or hearing the word "apple," a set of responses is elicited, which defines a range of associations with the word "apple." The range of responses and associations is stereotyped, since often we learn about objects in limited ways. For example, the most frequent associations of the word "apple" are probably "fruit" and "red." Relatively few people think of the apple in terms of its curved surface, its pulpy textures, or its stem.

We have discussed a concrete, familiar object; now let us take an important social science event--the American Revolution. In connection with this particular event, the first thoughts that come to mind may be associations such as revolution, England, George Washington, thirteen colonies, independence, and

Jefferson. The reader may select other attributes of this event, each one of which may denote a class concept; for example, time, geography, and colonization. There may be differences in the attributes selected by the author and the reader, but commonalities will also appear, because the author and the reader share a common educational and cultural experience.

The cognitive process involved in identifying this social event--the American Revolution--is identical to the one involved in the illustration with the apple. What we have done in each case is to identify a set of criterial attributes which define a part of the totality. This labeling of attributes we call <u>multiple labeling</u>.

An awareness of the range of attributes or aspects of any instance is a crucial prerequisite for the development of more complex classification behaviors. If we are able to specify many labels, we can classify instances in many categories. Thus, for example, we can classify the apple under the class "edible" or the class "having a curved surface" or the class "red." We could categorize the American Revolution under the class "revolution," or "independence," or "anti-British," or "war," and so on.

The number and kind of instances that can be brought under a particular heading depends on the criterial attribute selected. Thus, for the class "fruit," we could include such objects as pears and oranges; but if our criterial attribute were the class "red," we would select additional instances possessing the attribute "red." Similarly, we could construct a class, "wars on the American continent," including the American Revolution, the Civil War and the War of 1812; and we could construct a class, "British-American wars," including the American Revolution and the War of 1812, but excluding the Civil War.

Being aware that objects have many attributes is an important step in achieving awareness of the complexity of the environment. It provides the child with a broader range of information about events, and reduces the amount of stereotyped thinking. To illustrate; if we think of a Negro only as black, or of a Catholic in terms of his religion, or of the Chinese in terms of their politics, we are thinking in terms of only one attribute. But there are many other attributes of each of these social instances. Stereotyped thinking exists when classifications are based on a limited number of attributes. But when the child looks upon every object, every event, and every person as containing many attributes, it suggests to him that no one member is fixed in any particular class, but that it can be in any number of classes, depending on the criterial attribute selected. Thus, if the child is looking around the room for all things that are black, he may include a Negro, a bottle of ink, and a shoe. If we now ask him to think of all things that have feet, he may now put the Negro, the Caucasian, the chair, and the piano under one heading of objects having feet. In this way, the child can learn about the relativity of class membership.

Preferences for Attribute Selection

A number of studies have been made of the bases children use in forming classifications. It has been found that some children show strong preferences for certain criteria of classification. These preferences have been called styles of categorization, a term that means the consistent employment of particular classification criteria with different kinds of material. In classifying humans, for example, the presence of certain size, shape or color of physical features may be the criterial attributes on which classes are built. These are called descriptive criteria.

A second predisposition that has been identified is a tendency to classify items according to their functional interdependence--the relation of one object to another. We have called this the relational-contextual approach. As an example, if a horse and a wagon are included in an array of items, an individual may group these together because the horse pulls the wagon. Other individuals tend to classify on the basis of inferred attributes of items, which we have called categorical-inferential. In this case every instance in an array is an instance of the class; for example, an apple is thought of as a fruit, and a horse as an animal.

We have discovered that as children get older they make less use of relational-contextual criteria of classification, and more use of the descriptive and categorical-inferential criteria. That is, they tend to shift away from relating things on the basis of common functions or interdependence to the more objective type classifications. These changes reflect the child's increased awareness of the complexity of items, as well as the ability to deal with materials on the basis of their objective features. He relies less and less on his own unique subjective experiences as bases for classifying instances.

Apart from the tendency for styles of categorization to change with age, we have found strong personal preferences for particular modes of categorization in both children and adults. The preference for one or another mode is a personal characteristic. We know little about the origins or the modifiability of these classificatory orientations.

Complex Classification Behavior

Up to now we have discussed categorizations based on the ability of children to use a single attribute as the basis for classification. The ability of children to deal in combinations of attributes emerges later, only after the child has mastered certain kinds of intellectual tasks. He must, as we have indicated, be aware that single attributes can be used as the basis of classification--that an object has no fixed position in any one class, but can be a member of many classes.

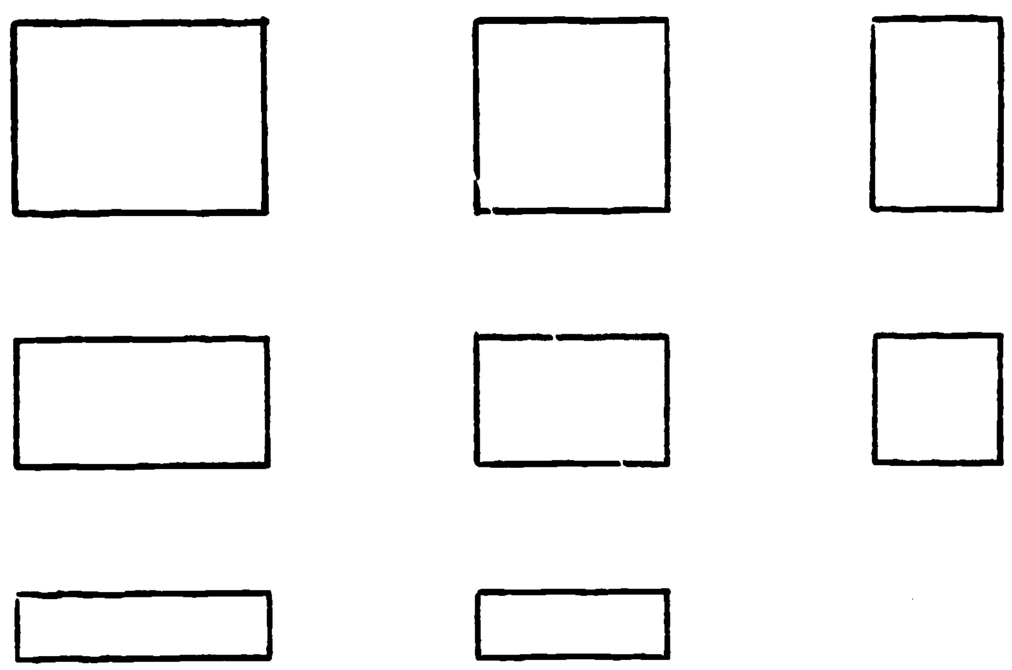
When the child understands the logic of single classification, he is ready to learn multiple classification. The essential logical processes of multiple classification are addition and multiplication.

Addition, or combining, of classes can be illustrated by showing children a picture of a group of people all of whom wear glasses, and another picture in which none of the people wear glasses. In each picture there are some persons who are bald, and others with hair. Addition of classes can be illustrated by forming the following classes: (1) people who are either bald or wear glasses; (2) people who either have hair or wear glasses; (3) people who either don't wear glasses or who are bald; (4) people who either don't wear glasses or who have hair; (5) people who either wear glasses or don't wear glasses; and (6) people who either have hair or don't have hair.

Multiplication of classes can be illustrated, using the same pictures. The following classes can be formed by multiplication: (1) all persons who wear glasses and who are bald; (2) all persons who wear glasses and who have hair; (3) all persons who don't wear glasses and who are bald; and (4) all persons who don't wear glasses and who have hair.

The ability to combine two or more attributes is a very significant one in the logical development of thought; it is a prototype of complex thinking, in which classes are combined and recombined as the needs of the problem dictate. In the process of combining and recombining a group of items, a child has to shift his criteria; flexibility is required in the manipulation of multiple criteria.

The significance of the ability to combine attributes was demonstrated in an experiment conducted with second and third grade children by the writer and two of his students, Frank Hooper and Frederick Stevens. In this study, the children were given a task in which objects of observation had two dimensions. Such a task can be described as a matrix task--in which one dimension of observation is on the horizontal axis and one on the vertical axis, which each sub-group so defined forming an entry in the matric. In the study, a set of blocks was used which decreased in size in both length and width. The scheme of the experiment, in a simplified form, can be represented as follows:



The child's task is to fill the void in the matrix, which requires that he pick a block that is smaller in each dimension than is the "preceding" block. In order to do this, he must be able to coordinate a decrease in length with a decrease in width. This task is one of logical multiplication--combining two attributes to form a new classification.

We found that children capable of performing this task were also capable of performing another very important function, namely, conserving--that is, holding a characteristic of an item as invariant in the face of transformation. Although there are other indicators of ability to conserve, we found that children who were able to multiply classes were always able to conserve.

For the reader unfamiliar with the classic conservation problem, it can be described briefly. A child is presented with two balls of clay, equal in size and identical in shape. One of these two balls of clay is transformed into a sausage or a pancake or a cup, and the child is asked whether the two pieces of clay are still equivalent. The ability to understand, that there was merely a transformation in shape, but no change in amount, is called conservation. In order for the child to understand this, he has to apply the principle of compensation, that is, to see that as the transformed piece of clay gains in length, it loses in width. This is, in effect, the ability to combine two attributes, namely, length and height, and to realize that there is interrelationship: if one measurement decreases, the other increases. The ability to conserve can easily be seen as relevant to many kinds of logical thought problems in the physical and social sciences. In economics, for example, dollars can be changed into other types of currency, with the purchasing power remaining constant.

Reversibility and Reciprocity

In order to deal with problems of multiple classification and interdependence of attributes, such as those just described, the child must be capable of two mental operations--reversibility and reciprocity.

Reversibility is a mental operation in which materials or ideas are reorganized so as to reconstruct the original state or class. In the example with the clay, reversibility is evident when the child is shown to be aware of the fact that the transformed piece can be rolled back into a ball, so that there are once again two identical balls. In arithmetic, reversibility is manifest in the proof or subtraction. In classifications, reversibility is manifest when classes are reorganized and then brought back to the original state. Comprehension of reversibility reflects the awareness that instances conserve their identity even though placed in another class.

A social science illustration of reversibility is the case of dollars which can be changed into British pounds, and then converted back into dollars. The value of the dollar, or the value of the money in question, has been conserved even though it appears in a different form. Also if the money is changed into other denominations, such as smaller coins or smaller bills, the amount is still the same.

Reciprocity connotes an interaction between things. For example, in economics, reciprocal relationships are evident when one country reduces tariffs and the other country involved sells it more goods. As applied to this specific case, the principle is that tariffs are related to the amount of goods bought and sold. An increase in tariffs causes a decrease in trade, while a decrease in tariffs leads to an increase in trade. There is a reciprocal relationship between trade and tariffs.

Understanding the principle of reciprocity is crucial in scientific and logical thought. As Flavell says:

> Reciprocity entails not the outright elimination or negation of a factor but its <u>neutralization</u>, that is, holding its effect constant in some way while a second factor is being varied. For instance, where the problem is to study the separate effects of kind of metal and length on the flexibility of a rod..., the younger child finds himself at an impasse; he cannot literally negate either variable, i.e., work with a rod not made of <u>some</u> metal and not possessing <u>some</u> length. The older child uses the reciprocal operation with great profit here. He takes two rods of different metals but of the same length (here length is not negated, but neutralized or controlled--not lengths <u>per se</u>, but length <u>differences</u> are annulled) in order to study the effect of kind of metal, and two rods of a single metal and different lengths to study the effect of length.
>
> The addition of the reciprocal operation to the subject's repertory in solving scientific problems brings a general advance in strategy and tactics: it disposes the subject towards the controlled experiment, that is, the nullification of one variable, not simply to study that one variable, but to study the action of some other variable free from error variance contributed by the first. The younger child negates a variable in order to study the causal efficacy <u>of that variable</u>. The older child develops a better strategy: negate or neutralize (whichever circumstances dictate; both negation and reciprocity are at his disposal) factor <u>A</u> in order to study the effects of varying factor <u>B</u>; negate or neutralize <u>A</u> and <u>B</u> in order to assess the uncontaminated action of <u>C</u>, and so on. Once again we see that the transition from concrete to formal operations is a transition towards genuinely scientific methods of analysis. (Flavell, 1963, pp. 209, 210.)

<u>Relationship of Complex Classification Behavior to Multiple Causality</u>

An important application of the competencies in multiple classification described above is to the awareness of single and multiple cause-effect relationships. Up to now we have focused on the relationship between instances of a class, the relativity of class membership, and combining and recombining of classes. The same intellectual process as that described in multiple labeling and multiple classification is relevant to the whole question of multiple causality, a crucial consideration in the social sciences, where events typically occur as the result of combinations of causes rather than of a single cause.

Let us backtrack for the moment and consider single causality (see Piaget, 1930 and Laurendean and Pinard, 1962). As with multiple labeling, so with causality we can begin by thinking in terms of single causes. However, as analysis of causal problems is made, it is soon apparent that no single cause is sufficient to explain any event. This is particularly true in the social sciences, which deal with complex events and complex causation questions. Therefore, it is important for the teacher to facilitate the child's understanding that events do not just happen but come about for reasons which are both observable (descriptive) and unseen (inferential). Coordination of attributes to build a new class is a process similar to coordinating a number of causative statements, leading to a description of multiple causation.

Common to these two operations--classification and causation--is the ability to perform logical multiplication, that is, to coordinate two discrete elements, fusing them into a single concept. It is a combinatory action, producing a new criterion by which items can be classified or explained. It is assumed here that the ability to multiply generalizes both to different kinds of classification and to causation.

Examples of Multiple Classifications and Multiple Relations

Let us now see how a specific teaching strategy can be designed for the classroom, based on knowledge of simple and multiple classification, and simple and multiple causality. Let us take a unit of study which is common in our public schools, namely, the pioneers. The purpose of this unit of study is to show something about the white man and the Indian in early colonial days. Consider first the tepee. What attributes of the tepee can be identified? We can talk about its function as a domicile, its portability, the materials from which it is made, and its shape. We can show the child how each of these attributes applies to this particular tepee. Consider next the log cabin of the pioneer. What attributes does the log cabin possess? We can use the same kind of criteria, i.e., the function, portability, the materials, and shape.

Let us now take the tepee and the log cabin and discuss some of their similarities. They have a similar function as a domicile. There is some similarity in materials, in that both use some wood. But there are also many differences. One is stationary and the other is portable. One is made entirely of wood, the other is made mostly of skins. One is conical in shape and the other is rectangular. Given these similarities and differences, the teacher can ask the children to examine these objects and explain or think about the significance of each of the attributes that are listed. Let us take, for example, the issue of shape. Why is a tepee conical? What function does this shape serve? It is related to fire; a simple way to make smoke escape is to leave a hole in the top of a conical structure. Why is a log cabin rectangular? This is a simple way to build with logs.

In this discussion we have begun to show how two rather discrete items share certain common properties, and also have differences. We focused on similarities and differences. But, thus far, we have concentrated on single attributes. We can now include in the discussion other types of domiciles, such as lean-tos and clap-board houses, which were also present in the pioneer community. We can also include forts, which have some features in common with houses. We can include many kinds of buildings, all of which have the common attribute of domicile, but which also have other qualities which permit sub-classifications. Then we can place in one group wooden, permanent domiciles, which could be forts, log cabins, and clap-board houses; and, in another group, portable domiciles, including wigwams, tepees, and lean-tos, etc.

The strategy suggested here is important; it requires the child to discover the attributes relevant for discussion, rather than the teacher supplying them. The multiple labeling and multiple classification are accomplished by the teaching providing the materials and asking the child to discover the relationships. From our research efforts it has become clear that letting the child provide the labels and discover the similarities and differences enables him to assimilate this information more readily, and to achieve an awareness of the complexity of items before him. This conclusion is consistent with the Piagetian theory, which holds that assimilation of information leads to alterations in the point of view. Thus, as these new bits of information become categorized in appropriate cognitive schemas, the schemas increase in content. The act of the child searching and labeling, uttering and hearing himself say "wood," "big," "small," and so forth, provides the context within which he acquires significant bits of information with which to identify environmental phenomena.

Our evidence is sufficiently strong to warrant the generalization that using a discovery-type approach, guided by the teacher, is better than other methods.

When Is a Criterial Attribute a Good One?

Teachers have biases as to what constitutes a "good" criterial attribute. Although various attributes or combination of attributes may be considered equally accurate and relevant, some are valued over others.

An illustration of the valuation system and its subsequent effect on classification behavior follows. Two types of tasks were given to a group of experienced social study teachers to demonstrate the relative significance of certain types of information. The respondents were presented with three items, a peach, an apple, and a banana, and were asked to pick any two of these three items and give a list of how they were alike. Most of the teachers picked the apple and the peach. Taking all the statements made by the entire group, seventeen different attributes were listed. The maximum given by one individual was eight, but every member of the group recognized the presence of each of the seventeen and agreed that the objects did contain these attributes. Why did not everyone list all seventeen attributes? This was discussed with the group. The reasons given reflected the conviction that certain kinds of responses were banal, unsophisticated, or unimportant. For example, the attribute of having a curved surface, common to both objects, was seen as an insignificant response. In general, the use of descriptive statements was seen as a reflection of low intelligence. This observation led to a discussion of what criteria a teacher used to decide if a response was good or not good. There was consensus that abstract ideas are better than non-abstract ideas.

At the next meeting with the teachers, a physical science experiment was described in which a strip of metal was placed over a candle and each end of the metal rose. The teachers were asked why this phenomenon occurred, and were permitted to request additional information. They asked such questions as, "How far was the candle from the metal?" "What was the metal made out of?" "For how long was the metal heated?" "Was the heat conducted equally in the metal?" "How long was the candle burning?" "What kind of candle was used?" In other words, a number of descriptive, factual questions were asked. No longer did the teachers consider such questions banal; they realized that these questions could, when properly employed, provide significant bits of information, the totality of which could lead to a desired answer to a question. The upshot of the discussion was that the teachers learned that the "goodness" of various criteria for classification depends on what questions one seeks to answer. Thus, for the botanist, the color of the flower may be a crucial criterion for determining its species. For the geologist, the shape and size of a rock may be the most important criteria for classification. For the social scientist, similar surface criteria such as the dates of battles, may or may not be important. The goodness of different types of criteria cannot be determined in general, but only with respect to the particular problem being studied.

Recapitulation

In summary, to this point, we have come to the following conclusions: (1) Instances (objects, events, and persons) are multi-dimensional, possessing many discrete attributes. (2) Attributes, singly or collectively, can be used as bases for forming classifications. (3) Classification on single attributes is easier than classification on multiple attributes, therefore the younger children are able to do it. (4) Through appropriate teaching strategies and demonstrations, children can learn that these single attributes can be combined to form new subclasses; to do this, they must be able to coordinate two or more attributes. (5) Reversibility and reciprocity are important intellectual operations needed to accomplish (4). (6) Given the competencies (4) and (5), children are able to conserve. (7) Integrating, or coordinating, attributes can be accomplished through the use of discovery procedures. (8) Labels of any kind may have a utility, which depends on the problem to be solved. (9) Labels selected by children reflect their preferences; but the reasons for such preferences, and the degree to which the preferences can be modified, are yet to be discovered.

Uses of Multiple Classification in the Curriculum

Methods in social studies can be selected which enable the child to accomplish two things simultaneously--to develop a strategy of search and discovery, and to acquire information. The kind of illustration given previously, about the houses, can be translated into other content areas. Let us take an example in American history. We present the children with the names of George Washington, George III, and Lafayette, and ask them in what ways any two of these three figures are similar, in what ways they are different. Suppose that most of the group picks George Washington and George III. At the most mundane level, they state that each have the same first name, they are both men, and they are both leaders, they dress similarly, and they are both influential figures in their country. Such information tells the child that two figures, despite differences of physical location and country of origin, have certain features in common.

We could deal next with the origins or the bases of the similarities between George Washington and George III. They have the same first name because they share a common culture in which this name is used. They are both men, which suggests that men in that era were predominant political power figures. That they dressed the same suggests they came from a similar social class. This illustration shows that, from a simple comparison, many questions can be evolved, all helping the child extend his understanding of these figures. In his reading and thinking, he will now consider commonalities as well as the differences which are often the exclusive emphasis in historical comparisons. We can extend the exercise, comparing Washington and Lafayette, Lafayette and George III; we can make a three-way comparison of commonalities and differences; and we can ask which two of the three figures are most alike. The nature of the relationship of each figure to the others will vary, depending upon the attributes chosen for comparison.

Through experiences of this kind, the child can learn about the relativity of relationships, how classes can be combined and recombined, how items in a class can be selected for a number of rational reasons, and, above all, how every instance is a complex of many attributes.

The attributes selected by the teacher, and the ways in which they are used, depend on the goals of the curriculum. If we are interested in studying leadership in the American Revolution, for example, then certain differences in attributes may be more important than similarities in these or other attributes. If we are studying the impact of certain cultural phenomenon on two people, certain similarities may become very important. In selecting significant attributes and analyzing commonalities and differences, and thereby evolving classification schemes, the child acquires not only the information about the figures, but also acquires practice in performing logical operations.

Such an approach is not limited to persons, but can also be applied to events. Take, for example, three very disparate events--the defeat of the Spanish Armada, the American Revolution, and the Boxer Rebellion. Here are three events that occurred at different points in time and at different places on earth. What are the commonalities, what are the differences, what can we learn from such an examination? The complexity of each of these instances is enormous, and, of course, there are only limited kinds of information that it would be important to select. We can readily ascertain some significant differences and similarities which could provide the child with a perspective that would further the goals of social science education. For example, in each of these three instances, the threat of major powers to inferior powers was overcome--the British defeating the Spaniards in 1588, the Americans finally defeating the British in 1781, and the Chinese throwing out the Western powers in the early 20th century. The commonalities among the British, the Americans, and the Chinese in each case were their presumed military and economic weakness, their relatively unsophisticated political and economic systems, and their strong desire for autonomy and independence.

The process of discovery of commonalities through labeling and identifying is crucial. The gains are lost if the teacher sets himself up as the source of such information.

Changing the Styles of Categorization

We have hypothesized that a more flexible use of styles of categorization will occur when children are encouraged to seek alternative classifications and when the list of alternative attributes is large. In encouraging expansion of the list of commonalities and differences, the teacher should not limit nor evaluate the responses, but accept them all as equally valid at first. Later on, the teacher can help the children determine which of the particular labels, or classification criteria, answer some questions or solve some problems better than others. In other words, the criteria for two people, certain similarities may become very important. In selecting significant attributes and analyzing commonalities and differences, and thereby evolving classification schemes, the child acquires not only the information about the figures, but also acquires practice in performing logical operations.

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The teacher should be sensitive to the children's styles of categorization, and encourage use of those styles being used least. Whether a child is responding primarily in a descriptive, contextual or inferential mode, he should be encouraged to work with the other modes. Our judgment about the value of such a strategy is based on research just completed in physical science with fourth-, fifth-, and sixth-graders, in which it was found that the children who solved problems most effectively were those who could ask about or perceive relationships on both the descriptive and categorical levels. The results suggested that the ability to shift from one criterion to another is important in solving classification problems. (Scott & Sigel, 1965)

When and how can such procedures to increase flexibility in styles of categorization be instituted? Here our conclusions are extrapolated from our research. We found that with certain classes of material, such as those which can be presented visibly to the child in three-dimensional form, competencies in multiple classification are evident as early as kindergarten and first grade. This would suggest that procedures to broaden styles of categorization could be instituted in the primary grades. Content would have to be selected which could visibly present to the child the possible alternative classification responses; later, use could be made of more symbolic representational material, such as pictures; and eventually, of words.

In practice, children in these early years have little experience with procedures of the kind described, which encourage broader and more flexible modes of categorization. The schools do not encourage them, but stress "correct" and "incorrect" methods of categorization. Our intelligence tests also discourage flexibility in categorization. Our evidence seems to indicate that if we could expose children at an early age to experiences that broaden categorization, it would facilitate thinking in more original ways.

Some social studies teachers teach children from a wide range of socio-economic groups. On the basis of our research, we would place greater emphasis on the use of three-dimensional objects as a way of introducing the tasks of categorization to very young children of average background, and to somewhat older children, perhaps ages six and seven, who come from economically deprived backgrounds (Sigel, Anderson & Shapiro, 1966). Deprived children have some difficulty in dealing with symbolic material.

Conclusion

The content and strategy suggested here represent an approach which should be an integral to every curriculum. It is our hope that this report provides some convincing suggestions about the relevance of child development research to the development of social science curricula. The job that remains for the curriculum developer and the teacher is considerable--that of integrating these suggestions, and hopefully others that come from similar investigations, into a coherent curriculum and teaching strategy.

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