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ABSTRACT

This study examines the relationship between development of a child's ability to coordinate perspective and his ability to conceptualize spatial relations on a map. One hundred and four school children from inner city, urban fringe, and suburban schools, grades K-6, were administered a Test of Coordination of Perspectives and a Test of Map Conceptualization. The first employed a three-dimensional model of buildings, trees, and streets with a doll as a movable, outside point of perspective; the second required a child to draw a map of a model village similar to that in the first test. Findings on the Perspectives Test follow those of Piaget and Inhelder, 1963, in which three developmental stages are evident. The Map Conceptualization Test indicates that there are three stages of development with distinct subgroups of progress. Analysis indicates that performance on the two tests was related and that socioeconomic status and race are variables that coordinate significantly with test results. Prior experience and training appear to have effected conceptualization, suggesting the usefulness of curricular sequences based on developmental stages to build map skills. (JH)

PERSPECTIVE ABILITY AND MAP CONCEPTUALIZATION IN ELEMENTARY SCHOOL CHILDREN

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The post-Brunerian era of educational psychology in the United States has been characterized by a renewed interest in the developmental theories of the Swiss epistemologist Jean Piaget. Researchers in geographic education have demonstrated considerable interest in testing the applications of Piaget's theories, especially in the areas of map skills. The trained geographer, upon studying Piaget's work, is immediately aware of the logical relationship which exists between Piaget's and Inhelder's (1963) sequential development of the ability to coordinate perspectives, for example, and traditional map reading skills development (Miller, 1967, 1968; Eliot, 1966; Towler, 1969, 1970). The data are not always conclusive, however, and seemingly contradictory at times. On the other hand, empirical investigation suggests that the ability to complete map tasks may not be related to perspective ability (Beilin, 1970). One area of concern which the research literature does not discuss is the relationship between perspective ability and the ability to conceptualize the spatial function of maps. The principal problem under-

lying the present study is to examine the relationship between development of children's ability to coordinate perspectives and their ability to conceptualize the spatial relations represented on a map.

The ability to coordinate perspectives requires an understanding that objects and groups of objects appear differently from different vantage points. Perspective ability involves superimposing a mental grid system on an area in order to predict what would be seen from viewpoints other than the one presently occupied (Miller, 1968).

The ability to conceptualize the spatial relations represented on a map refers to an understanding that each position on a map is spatially related to all other positions simultaneously. It involves, in addition to the perception of symbols separated in space, the conceptualization of the positions of symbols relative to one another from different points of view.

PROCEDURES

One hundred four elementary school children from grades K through 6 inclusive were administered a Test of Coordination of Perspectives and a Test of Map Conceptualization. Schools attended by the subjects reflected inner city, urban fringe, and suburban characteristics. The chronological ages of the subjects ranged from 5 years 5 months to 14 years 5 months. The sample included an equal number of males and females.

Forty-one of the subjects were black.

The Test of Coordination of Perspectives is patterned after Towler's (1969) modification of the three-mountain task of Piaget and Inhelder (1963). The test uses three questioning strategies involving a circular board with plastic buildings of model railroad HO gauge size (Fig. 1).

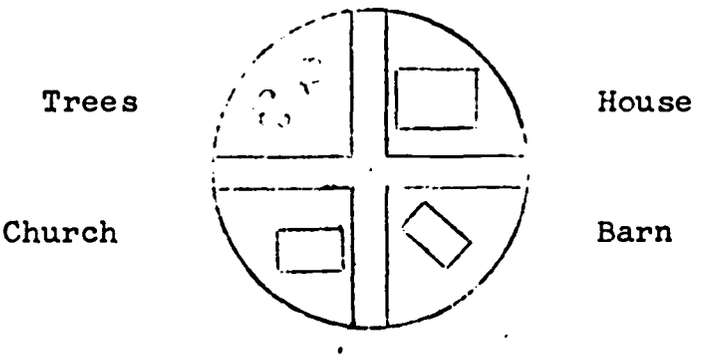

Fig. 1.--Diagram of Model
for Test of Coordination of Perspectives

First, using a duplicate set of board and buildings the child is asked to reconstruct the view as seen by a doll placed at various positions around the original model. In the second strategy, eight different photographs of the model are shown to the child. The child is asked to select from the eight pictures that seen by the doll when placed at various positions around the model. The third task, the converse of the second, requires the child to place the doll on the model so its view coincides with that shown in one particular photograph selected by the researcher.

The Test of Map Conceptualization requires the subject to draw a map of a model village using props similar to those in the prior test (Fig. 2). The task does not reflect upon

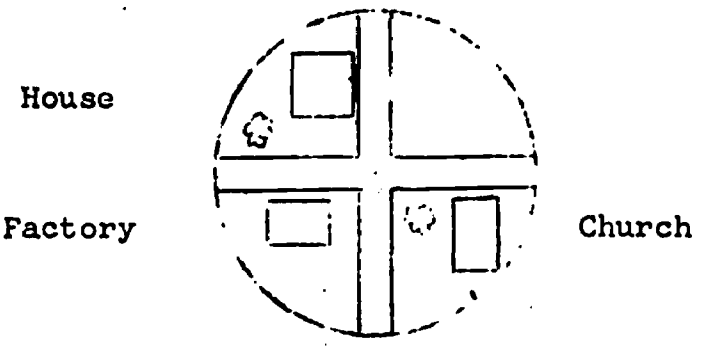

Fig. 2.--Diagram of Model for Test of Map Conceptualization

the child's artistic ability or proficiency with map symbolization. Scores are assigned only for those elements of the task requiring the conceptualization of the positions of the objects relative to one another.

Data analysis focused on the relationship between perspective ability and map conceptualization. The effects of socioeconomic status, academic achievement, race and sex on the coordination of perspective and map conceptualization were also analyzed.

RESULTS

Test of Coordination of Perspectives

Analyses of the Test of Coordination of Perspectives revealed a pattern of development identified by earlier

studies (Piaget & Inhelder, 1963; Eliot, 1966; Miller, 1967, 1968; Towler, 1969, 1970; Beilin, 1970). Three distinct, sequential stages are evident. Children in Stage I (4 to 5 years of age) do not understand the questions and are unable to participate in the tasks. In Stage II (6 to 8 years of age) children have difficulty recognizing any viewpoint other than their own. In replicating the model village from different views, children of this age go to considerable efforts to represent the view seen by the doll, but the view reconstructed coincides with their own. In Stage III (9 to 12 years of age) children show progressive discrimination and coordination of perspectives and successfully complete the tasks by 12 years of age.

Test of Map Conceptualization

Data from the Test of Map Conceptualization suggest that the ability to accurately represent spatial relations on a map also improves with age. Within the overall pattern of task completion and age, the researchers observed several distinct stages of development in the subjects' ability to spatially relate objects on a map. The following sequence, identified by the authors, demonstrates the progressive development of children's map conceptualization.

Stage I: (5 to 7 years) At this stage the child does not understand the concept of a map. Drawings show no attempt to represent the spatial distribution of objects. Cross-roads are not drawn and frequently the objects represented in the drawing are unrelated to those in the model.

Stage II: (7 to 11 years) Children at this stage comprehend the spatial function of maps.

Substage IIA: (7 to 9 years) In this stage the concept of a map is understood, but the child is unable to co-ordinate his perceptions of spatial distributions. Cross-roads and buildings are depicted on the map, but their arrangement is disorganized. Buildings may be located on the roads or outside of the map itself.

Substage IIB: (8 to 11 years) The concept of a map as a picture of reality is complete. Objects now appear in quadrants rather than on the road or outside of the map boundaries. However, the child views each object separately or at the most in relation to only one other object, rather than to all other objects simultaneously. Therefore, objects are located in the wrong quadrants relative to other objects. Within the quadrant the child does not consider the location of the object relative to the sides of the quadrant.

Stage III: (9 to 12 years) The child in this stage perceives all the objects at one time and accurately represents their relative positions.

Substage IIIA: (9 to 12 years) In this stage the child has conceptualized the relative positions of the objects from different points of view. All ob-

jects are in the correct quadrants relative to all other objects. However, placement within the quadrant relative to the quadrant sides continues to be a problem for the child

Substage IIIB: (10 to 12 years) At this stage development of the concept of relative positions of objects from different points of view is complete. The child draws all objects correctly in relation to all other objects and to the sides of the quadrants. The child has mastered the ability to conceptualize simultaneously several variations in the relationships of objects and transfer those relationships to a two-dimensional surface

Statistical Analyses

The major objective of this research was to assess the relationship between the ability to coordinate perspectives and the ability to conceptualize the spatial relations of objects on a map. Performance on the tests is significantly related ($p < .05$), with correlation being .56. The data suggest that the cognitive functions necessary to conceptualize the spatial arrangement of objects on a map develop in a sequence similar to mental functions required for the coordination of perspectives.

Differences between abilities of various socioeconomic groups to coordinate perspectives and conceptualize spatial relations on a map were investigated. The researchers employed an analysis of covariance procedure adjusting for the effects

of age and reading ability. The procedure revealed a significant difference ($p < .01$) between the abilities of high and low to middle SES groups to coordinate perspectives. No significant difference in the map conceptualization abilities of the SES groups ($p > .05$) was observed.

The differences in performance of the socioeconomic groups on the perspective tasks reaffirm that perspective ability is not normally a component of the school curricula. Therefore, school training does not equalize for differences in non-school experience of different SES groups in the development of perspective ability. The data suggest, however, that experiences promoting map conceptualization are similar for all socioeconomic groups. Presumably those experiences are provided by the social studies curriculum of the school.

However, the researchers caution against over interpreting data suggesting SES effects. Socioeconomic status in this study was generalized by school. The complexities in assessing the effects of SES on performance are noted throughout the literature. As in most instances, only generalized conclusions may be posited on the basis of SES data.

Analysis for the effects of race reveal a significant difference ($p < .05$) in favor of white children in the development of perspective ability and map conceptualization. The majority of black children in the study came from low SES backgrounds while only white children came from upper SES backgrounds. That dichotomy suggests a close relationship

between race and SES. On the other hand, differences in the development of map conceptualization are not significantly different ($p > .05$) as an effect of SES, but are significantly different ($p < .05$) when race is considered. Black children exhibit a developmental lag in the ability to conceptualize spatial relations on a map. The researchers interpret the data to suggest that the developmental lag is a function of SES and training in the completion of spatial tasks such as mapping. The curriculum is probably not providing necessary experiences in spatial tasks to offset the pronounced effects of SES upon black children. Such a position is supported by recent research comparing the map skills improvement of black and white children receiving training in reading and map skills (Stoltman & Goolsby, 1973).

Differences on task performance based on sex were not significant ($p > .05$). The pattern of development of perspective ability and map conceptualization was similar for both sexes of the study sample.

CONCLUSIONS

The present study demonstrates that children having difficulty coordinating perspectives also have difficulty conceptualizing the spatial relations of symbols on a map. An untested premise of prior studies was that a positive relationship exists between the ability to coordinate perspectives and the ability to understand maps and mapping. That

premise is tested and supported by the data in the present study.

The data suggest a developmental sequence in the conceptualization of spatial relations on a map, influenced by both prior experience and training. The research suggests that curricular sequences for map skills in the elementary grades must take into account the developmental stages in the ability to conceptualize spatial relations on maps. The effect will be an invariate set of map experiences which complement the developmental stages sequence leading to conceptualized mapping by the child.

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