DOCUMENT RESUME

ED 064 105 SE 013 728

AUTHOR	Howe, Ann C.
TITLE	A Study of the Relationship of Geometry to Acquisition of Conservation of Liquid.
PUB DATE	Apr 72
NOTE	3p.; Paper presented at the National Association for Research in Science Teaching, Chicago, Illinois, April 1972
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	Cognitive Processes; *Concept Formation; *Conservation (Concept); Elementary School Science; *Geometry; *Learning Processes; *Perception; Scientific Concepts; Student Evaluation

ABSTRACT

Twenty second- and third-grade children were tested on their ability to make judgements of certain area and volume equivalences. The children were then presented a conservation-of-liquid task. Of the 17 children who gave correct conservation responses, only two had solved the area and volume problems. Thus, contrary to what is suggested by learning theorist R. Gagne, knowledge of area and volume relationships is not a prerequisite for conservation of liquid. Gagne also suggested that acquisition of conservation of liquid in one type of container (e.g., rectangular) might precede conservation of liquid in another type of container (e.g., cylindrical), but no child was found who gave the correct response for rectangular containers who did not also give the correct response for cylindrical containers. The answers children give when asked to explain how they know that the quantity of liquid is the same after a transformation can be categorized as: (a) Identity ("It's the same water; nothing changed."); (b) Compensation ("It's fatter but lower."); and (c) Reversibility ("If you poured it back, it would be the same."). Identity was used by 78 percent of the seven-year-olds and 68 percent of the eight-year-olds, with 93 percent of the ten-year-olds using Compensation. These results are interpreted to mean that the initial acquisition of conservation of liquid is not dependent upon knowledge of geometry. (Author/PR)

A Study of the Relationship of Geometry to Acquisition of Conservation of Liquid

(Presented at the Annual Meeting of the National Association for Research in Science Education in Chicago, April, 1972)

Ann C. Howe
Syracuse University

Effective elementary science curricula must be based on knowledge of how children think as well as on knowledge of science. The work of Piaget and others indicates that young children think in unexpected ways and that logical thought processes are only gradually acquired during childhood. An important milestone in the growth of logical thinking is the acquisition of conservation, the knowledge that quantity remains the same through changes in arrangement or shape. When children are asked to explain how they know that the amount of liquid or solid remains the same they often reply, in their own words, that the increase in one dimension is offset by a decrease in another dimension. Many Piagetians believe that conservation is acquired when a child becomes able to think about two dimensions at once in an intuitive, non-metric way. Learning theorists believe that conservation is a task and that the ability to perform it is acquired through a process of cumulative learning. Gagne (1) has suggested a learning sequence for conservation of liquid which includes non-metric rules concerning the determination of area and volume, the effect of a change in one dimension, compensatory changes in two dimensions, and interior volume of a container. He proposes that the essential element in acquisition of conservation is not logical processes but concrete knowledge of volumes, areas, lengths, etc.

I. Twenty second- and third-grade children were tested on their ability to make judgements of certain area and volume equivalences (see Protocol). The children were then presented a conservation-of-liquid task. Of the 17 children who gave correct conservation responses, only two had solved the area and volume problems. Thus, knowledge of area and volume relationships is not prerequisite for conservation of liquid. Gagne (1) also suggested that acquisition of conservation of liquid in one type of container (e.g., rectangular) might precede conservation of liquid in another type of container (e.g., cylindrical), but no child was found who gave the correct response for rectangular containers who did not also give the correct response for cylindrical containers.

II. The answers children give when asked to explain how they know that the quantity of liquid is the same after a transformation can be categorized as (a) Identity ("It's the same water; nothing changed."), (b) Compensation ("It's fatter but lower."), (c) Reversibility ("If you poured it back, it would be the same."). Second-, third-, and fourth-grade children in two schools, both working-class, were presented the conservation-of-liquid task as described in Items 5 and 6 of the Task Protocol. Those who gave the correct responses were asked, "How do you know?". The responses were categorized according to (a), (b), and (c) above. Two responses were recorded for each child; one for Item 5 and one for Item 6. The results are tabulated below, according to the age, and with the two groups combined.

Age	Identity	Transition (Iden.-Comp)	Compensation	Reversibility
7	15 (78%)	0	4 (22%)	0
8	18 (68%)	2 (7%)	7 (25%)	0
9	16 (47%)	2 (6%)	9 (26%)	7 (21%)
10	0	1 (7%)	13 (93%)	0

These results are interpreted to mean that children acquire conservation of liquid before they understand the geometric relationships involved, or, to state it another way, that the initial acquisition of conservation of liquid is not dependent upon knowledge of geometry. Once the concept is attained, it is generalizable to other shapes of containers. The finding that the nature of the explanation for conservation changes as children get older suggests that the restructuring of experience is an important element in the growth of logical thinking.

(1) Gagne, R. "Contributions of Learning to Human Development". Psychological Review, 1968, 3, 177-191

Ann C. Howe, Syracuse Univ.

Conservation of Liquid Protocol

1. Show child two paper rectangles, 2" x 6" and 4" x 3".
   a). Do these rectangles have the same area? Are they the same size? Is one as big as the other?
   b). Why do you think so?
   c). How would you find the area? How would you measure it?

2. Show child two blocks, 1" x 2" x 6" and 2" x 2" x 3".
   Repeat (a), (b), (c), substituting "volume" for "area".

3. Show child two plastic cylinders, 4" high, 2" diameter and 6" high, 1" diameter.
   Repeat (a), (b), (c) above.

4. Present block composed of 12 one-inch cubes, 2 x 3 x 2. Give child square piece of cardboard 2" x 2" and ask him to build block which "is just as big" as the one presented, using the piece of cardboard as the base.

5. The child is shown two clear plastic cube-shaped containers, partly filled with colored water. The water levels are the same in the two containers. The child is asked whether he thinks there is the same amount of water in the two cubes; the water level is adjusted until he is satisfied that the amounts are the same.
   a). The water from one of the containers is poured into a tall rectangular clear plastic container. The child is asked, "Does this tall container (experimenter pointing) have the same amount of water as this (pointing to the cube which still contains water) - or does it have more or less?". The question is repeated if the child seems in doubt or does not seem to understand.
   b). How do you know?
   c). The water is poured back into the cube. The procedure is repeated with a shallow rectangular clear plastic container.

6. The above procedure repeated with cylindrical containers.