A COORDINATED REVIEW OF RECENT RESEARCH CONDUCTED IN THE DEPARTMENT OF ELEMENTARY EDUCATION UNIVERSITY OF ALBERTA RELEVANT TO MATHEMATICS EDUCATION Part II

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Conservation is often used as a criterion in the assessment of concept acquisition. Investigators who use the concept of conservation in this manner are often criticized for the method they employ. The "clinical method" which consists of observing, interviewing, and recording is attacked frequently. However, few critics offer an alternative approach.

One alternative was developed by Sawada.[1] He conducted a study of length conservation in 62 kindergarten and Grade I children. The secondary purpose of his study was to ascertain whether or not an essentially non-verbal method of communicating the response criteria to the subjects would lower the age at which they gave evidence of possessing conservation of length. Sawada's non-verbal technique made use of calipers and a response apparatus to reward correct answers with a candy. The candy was placed behind one of three doors in a box. Over each door was a caliper with a model fit. That is, over one door a rod was inserted in the caliper so that it was too short, over the middle door the rod fitted exactly into the caliper, and over the last door the rod was too long for the caliper. The subject had another caliper that he could use to test the fit in the test situation. After a transformation was applied to the object, the subject was asked to open the door corresponding to the type of fit he thought there would be now without using his caliper after the transformation.

The results of this study showed that the threshold age at which 50 percent of the subjects conserved length was between five years and four months, and six years and two months. Thus, if the response criterion is essentially non-verbal, children are able to give conservation responses as much as two years earlier than they would if required to give verbal responses.

Sawada's major purpose was to explore the role of transformations (translations and rotations) in the child's conservation of length. He found that conservation of length cannot be solely explained in terms of the transformations applied to the objects exhibiting length. Neither could the factors extracted from the conservation test be defined solely in terms of the state properties of the objects to which the transformations were applied. Both state and transformation properties had to be used to interpret the factors extracted out of the test performance. Sawada also found that an illusion subtest was significantly more difficult than any of his other subtests. Age

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[1]Sawada, D., "Transformations and Concept Attainment: A Study of Length Conservation in Children." Unpublished Master's Thesis, University of Alberta, Edmonton, 1966.

correlated significantly with performance on the test but intelligence, as given by the "Detroit Beginning First Grade Intelligence Test" (1937), did not.

Should conservation be induced in young children? If Piaget is correct when he claims that conservation is necessary for any rational activity, then certainly the acquisition of conservation should be of prime concern to teachers. But why not let it take its natural course of development? One major problem is that there is an increasing pressure being placed upon teachers and curriculum planners to introduce more sophisticated mathematical concepts at younger and younger ages. The Cambridge Report (1963) is an indication of such a trend. If the mathematical concepts outlined in the report are to be understood by the children rather than merely memorized, then conservation in related areas is important. Thus, the inducing of conservation becomes a relevant problem.

Sawada's finding (referred to earlier) that the concept of conservation is present on the non-verbal level at an earlier age than indicated by Piaget might have an important bearing on the problem of teaching conservation to children. This strongly suggests that the preliminary stages of inducing the concept of conservation and mathematical concepts should be approached from a level that is as free from verbalization as possible.

Towler[2], on the other hand, attempted to induce conservation by pointing out the important aspects of this concept in small groups. He used a sample of Grade I students. Forty non-conservers and 40 partial conservers were assigned randomly to an experimental group and a control group. His major hypothesis was that learning of conservation could take place if the crucial aspects of conservation could be isolated and presented to the students in such a way that they could understand them. He hypothesized that these relevant variables were (a) an understanding that a quantity retains its identity during transformation, (b) an understanding of compensatory relationships, and (c) an understanding of the principle of reversibility.

On the basis of this hypothesis, Towler designed a training session for the experimental group which he hoped would lead to the understandings mentioned above. To provide training in the identity relationship, Towler asked two types of questions. A drink was poured from a jug into a can and the subjects were asked, "Does pouring change the kind of drink?" The second type of question asked "Does pouring change how much (amount) there is to drink?"

Another aspect of the training session was designed to confront the subjects with the compensatory relations of height and width. Containers of various dimensions were used so that the levels of the liquids varied. Students were asked to predict where the levels would be and to explain why the level was higher or lower in a given container than in the original standard. A final aspect of the training session was concerned with the ability of the child to

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[2]Towler, J.O., "Training Effects and Concept Development: A study of the Conservation of Continuous Quantity in Children." Unpublished Doctoral Thesis, University of Alberta, Edmonton, 1967.

relate what he had just discussed to pictorial representations of similar situations.

It was thought necessary to describe Towler's training session somewhat since he claims that it was highly successful in inducing conservation in the experimental group. A significant number of non-conservers and partial conservers in the experimental group acquired conservation and, with the exception of one subject, were able to retain conservation over a two- to three-week period. They also were able to transfer their learning to a new situation using different materials (discontinuous quantity). While the experimental group showed this improvement, there was no change in the control group's understanding of conservation.

(To be continued)

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