

## **Abstract of a Doctoral Dissertation**

# **Title: Characteristics of Cognitive Developmental Processes in Third- and Sixth-Grade Elementary School Children —using weight conservation as a clue—**

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This study aimed to elucidate the process of acquiring the concept of weight conservation in school children. According to Piaget (1941), the concept of weight conservation is acquired at approximately 10 years of age. This period is known in Japan as “the crisis about the ages of 9 or 10” or “the wall about the ages of 9 or 10.” It is considered to be a period of qualitative transformation in the development of schoolchildren. Since this period coincides with the acquisition of the concept of weight conservation, we considered it necessary to understand the developmental characteristics of 9- and 10-year-olds to clarify the process of acquiring the concept of weight conservation. In Chapter 1, we reviewed the period about 9 or 10 years of age. The age of 9 or 10 years is a period of change from concrete thinking to abstract thinking, a period of development of spoken language and acquisition of written language simultaneously. This is a time of highly significant changes, such as a change in self-awareness and an increased emphasis on relationships with friends, as well as a period of significant changes in cognition, personality, and social skills. On the basis of these developmental characteristics in this age group, four empirical studies were conducted to clarify the process of acquiring the concept of weight conservation. In the study on “conservation of weight” in the 8–10-year age group, a temporary decrease in the pass rate was observed in the third grade of elementary school in the “conservation of weight” task. Most judgments were subjective until the second and third grades, but “sentences with an adversative structure” and quantity-conscious reasons for judgments increased in the fourth grade. From these results, we speculate that the decrease in the pass rate in the third grade is due to the shift to reject subjective judgments and focus on measurable “quantity” in the “conservation of weight” task. In the study on the discovery of units of weight among schoolchildren, “conservation of weight” was established at 10 years of age, while the discovery of “individual units” of weight was somewhat later, after 11 years of age. In some cases, the discovery of “individual units” of weight proceeded

without sufficient understanding “conservation of weights.” From these results, it was considered that the discovery of “individual units” of weight during the school-age period involves two paths: “from conservation to individual units” and “directly to individual units without conservation.” The time difference between the establishment of “conservation of weight” and the acquisition of “individual units” of weight in “from conservation to individual units” was inferred to be due to a re-examination of the “conservation of weight.” In the case of “directly to individual units without conservation,” the acquisition of “conservation of weight” is insufficient during the school-age period, and the logical way of thinking takes precedence. This way of thinking has the potential to acquire or ensure weight conservation after school age.

The study on the process of acquiring the concept of weight conservation in the third to sixth grades was longitudinal. Three groups were found from a questionnaire survey conducted over 4 years: a group considered to have already acquired the concept of weight conservation in the third grade; a group considered to have acquired it around the fourth grade; and a group that first answered correctly and then regressed to wrong answers. The children in the first group often explained weight conservation by “simple identity” in the third grade. However, from the fourth grade, they began to use abstract words or tried to give logical explanations. The children in the second group made similar attempts at explanations as the first group from the fourth or fifth grade onward. The reason for the changes observed in the two groups can be attributed to the detachment and reconstruction of the everyday concepts. Consequently, it seems possible to grasp and assess changes comprehensively. The newly acquired concepts and knowledge play a role in detaching and reconstructing everyday concepts. The analysis of the third group suggests that even in the upper grades, a few children cannot detach and reconstruct everyday concepts.

In “Teaching the Concept of weight in Elementary School” we examined how the teachers understand the conservation of weight and what they emphasize in their teaching based on their specific lesson records. It was clear that the teachers prepared their lessons on the basis of children’s cognitive developmental characteristics, and that as children develop the ability to think abstractly and logically at 10 years of age, their scientific understanding of weight becomes more profound. The classes on “weight” were conducted by relying on the children’s thinking.

Based on these studies, it can be said that the concept of weight conservation is acquired at approximately 9 or 10 years of age, which is considered a qualitative transition point in development. On the other hand, a phenomenon was observed in which the concept of weight conservation regressed to a state of non-acquisition afterward. This can be regarded as a process of reexamination and deepening of awareness. Regarding everyday and scientific concepts, the formers are separated from and reconstituted by latter. The content of and the time required for re-questioning differ for each child.

During this period, a zone with three dimensions exists: the time and space children need to pass through and the manner in which they pass through. Children pass through that zone in their own way. This suggests the diversity of passage in the “developmental zone at 9 or 10 years.”