

## DEVELOPMENT OF "THEORY-DEPENDENT TEACHING" IN MATH EDUCATION

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*In problem solving in arithmetic, the emphasis is on thinking logically, but the main method is inductive thinking. In mathematics, the main method of thinking is deductive, for example, in the argumentation of proof problems. Therefore, we decided to see if we could bridge the gap between the two teaching methods. The purpose of this study is to develop a model of teaching that incorporates "theory-dependent teaching" based on problem solving and deductive thinking in arithmetic. By doing so, we can expect the possibility of renewing the old methods of teaching problem solving in arithmetic.*

### 1. Purpose of the study

The originality and creativity of this research are the following two points.

The first feature is that it attempts to improve teaching by introducing "theory-dependent teaching," which has not traditionally been used in arithmetic.

The second feature is that it does not limit itself to theoretical considerations, but develops class models that can be applied at the practical level through the conception, practice, and verification of specific classes.

In arithmetic, problem-solving classes are the mainstream. This is a "theory-seeking class" in which students are asked to inductively discover rules (formulas, definitions, theorems) from the ideas and results obtained through mathematical activities. However, while this approach works well for problem solving in arithmetic, it has its limitations in mathematics. The reason for this is that the learning content is abstract and advanced, and there is a large gap between the content and the students' existing knowledge.

On the other hand, there are "theory-dependent classes," which focus on problem-solving activities by having students think inductively, deductively, analogically, or integrally based on rules (formulas, definitions, theorems). In a class where the teacher teaches the rules first and then focuses on thinking activities using the rules, the teacher teaches the knowledge necessary for consideration, which is characterized by new discoveries that have not been noticed before and divergent expansion of thinking from there.

By incorporating this "theory-dependent teaching" into arithmetic classes, it will be possible to foster an attitude of trying to solve problems mathematically using inductive and deductive methods based on mathematical views and ideas.

### 2. Research methods

In this study, we will encourage students to make sense of conventions (formulas, definitions, theorems) and to explore the process of their generation, and to solve problems by asking why the formula is the way it is and why we can say so. For example, in the area of a trapezoid, the formula for area is  $(\text{top base} + \text{bottom base}) \times \text{height} / 2$ . Present the equation at the beginning and ask students to think about why the equation is given. In this way, we will consider the grade levels, units, and times in which to incorporate "theory-dependent teaching," examine its effectiveness, and develop a lesson plan.

Ikeda, Y. (2007). Theory-dependent Problem-Solving Learning Theory-Dependent Problem-Solving Learning: Its Methods and Evaluation of Scientific Thinking. *Research Report of the Japanese Society for Science Education*, 24 (5), 33-38.