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Learning to solve problems that you have not learned to solve

Strategies in mathematical problem solving

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Abstract

This thesis aims to contribute to a deeper understanding of the relationship between problem-solving strategies and success in mathematical problem solving. In its introductory part, it pursues and describes the term strategy in mathematics and discusses its relationship to the method and algorithm concepts. Through these concepts, we identify three decision-making levels in the problem-solving process.

The first two parts of this thesis are two different studies analysing how students' problem-solving ability is affected by learning of problem-solving strategies in mathematics. We investigated the effects of variation theory-based instructional design in teaching problem-solving strategies within a regular classroom. This was done by analysing a pre- and a post-test to compare the development of an experimental group's and a control group's knowledge of mathematics in general and problem-solving ability in particular. The analysis of the test results show that these designed activities improve students' problem-solving ability without compromising their progress in mathematics in general.

The third study in this thesis aims to give a better understanding of the role and use of strategies in the mathematical problem-solving processes. By analysing 79 upper secondary school students' written solutions, we were able to identify decisions made at all three levels and how knowledge in these levels affected students' problem-solving successes. The results show that students who could view the problem as a whole while keeping the sub-problems in mind simultaneously had the best chances of succeeding.

In summary, we have in the appended papers shown that teaching problem-solving strategies could be integrated in the mathematics teaching practice to improve students mathematical problem-solving abilities.

Keywords: Problem-solving strategies, problem-solving ability, variation theory, design principles, classroom teaching, design-based research (DBR)