Lösa problem
Om elevers förutsättningar att lösa problem och hur lärare kan stödja processen

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Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för avläggande av filosofi doktorsexamen framläggs till offentligt försvaret i N420, Naturvetarhuset, fredagen den 17 maj, kl. 12:30. Avhandlingen kommer att försvaras på svenska.


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Abstract
In mathematics education, there is generally too much emphasis on rote learning and superficial reasoning. If learning is mostly done by rote and imitation, important mathematical competencies such as problem-solving, reasoning, and conceptual understanding are not developed. Previous research has shown that students who work with problems (i.e. constructs a new solution method to a task), to a greater extent increase their mathematical understanding than students who only solve routine tasks. The aim of the thesis was to further understand why teaching is dominated by rote learning and imitation of procedures and investigate how opportunities for students to solve tasks through problem-solving could be improved. This was done through the following studies. (1) Investigating the relation between types of solution strategy required, used, and the rate of correct task solutions in students’ textbook task-solving. (2) Studying the relationship between students’ beliefs and choice of solution strategy when working on problems. (3) Conducting a textbook analysis of mathematics textbooks from 12 countries, to determine the proportions of tasks that could be solved by mimicking available templates and of tasks where a solution had to be constructed without guidance from the textbook. (4) Conducting a literature review in order to characterize teaching designs intended to enhance students to develop mathematical understanding through problem solving and reasoning. (5) Conducting an intervention study were a teacher guide, structured in line with central tenets of formative assessment, was developed, tested, and evaluated in real classroom settings. The teacher guide was designed to support teachers in their support of students’ in their problem-solving process. Studies I, II and V were conducted in Swedish upper secondary school settings. The students’ opportunities to solve tasks through problem-solving were limited: by the low proportion of problems among the easier tasks in the textbooks; by the students’ choice of using imitative solution strategies; and by the guidance of solution methods that students received from other students and their teachers. The students’ opportunities were also limited by the students’ beliefs of mathematics and the fact that a solution method of problem tasks was not always within reach for the students, based on the students' knowledge. In order to improve students’ opportunities, teachers should allow students to work with more problems in a learning environment that lets students engage in problem-solving and support students' work on problems by adapting their support to students' difficulties. The results also give implications for the construction and use of textbooks and how the use of the teacher guide could be part of teachers’ professional development and a tool that teacher students may meet within their education.

Keywords
problem solving, reasoning, beliefs, textbook, teaching, formative assessment, design research, upper secondary school