GeoGebra, Enhancing Creative Mathematical Reasoning

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Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för avläggande av filosofie doktorsexamen framläggs till offentligt försvar i Sal N320, byggnad Naturvetarhuset, onsdagen den 26 april, kl. 13:00.
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Title
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Abstract
The overall aim of the thesis is to bring some insights into how to design a didactical situation including dynamic software (GeoGebra) to support students' mathematical problem solving and creative reasoning as means for learning. The overall aim has been concretized in four studies focusing different aspects of students' problem solving, reasoning and learning in a didactical situation designed to invite the students to construct their own methods supported by GeoGebra. An intervention was designed were students solved tasks designed for the working with tasks in pairs, sharing one computer. The methods used in the first three studies included in the thesis are qualitative where data consisted of recordings of students’ conversations and computer activities during solving mathematical tasks. In the fourth study a quantitative method was applied. The data from study IV consisted of solution frequency of intervention-tasks, results of post-test, and students’ current grades.

Results of the first three studies show qualitative aspects of students solving of task with assistance of GeoGebra. GeoGebra has been shown to support collaboration, creative mathematical reasoning, and problem solving. Students have been found using GeoGebra to formulate input according to questions and hypotheses, and used output as feedback to answer questions and verify/falsify hypotheses. In the last two studies students' engagement in reasoning, utilizing of GeoGebra, and learning was examined by comparison between they who solved tasks with or without guidelines how construct the solution. Results showed that students who solved unguided tasks utilized the potential of GeoGebra more, understood their solutions better, and learned the mathematical content better. Conclusions are, students who successfully solve a task without guidelines in larger extent use the potential of GeoGebra to support problem solving and reasoning, compared to students who solve tasks with guidelines including how to solve the task. Furthermore, students who successfully solve a task without guidelines learn the included mathematical content better than those who successfully solve a task with guidelines.

Keywords
Dynamic software, problem solving, reasoning, linear functions