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Feedback from dynamic software supports creative mathematical reasoning

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Previous studies have shown that students learn mathematics better when they are engaged in creative reasoning, but that students in regular teaching mainly undertake imitative reasoning. It is therefore important to develop and examine didactical designs that support creative reasoning. These studies examine a didactic design where students work in pairs solving a complex task supported by dynamic software. The studies show that dynamic software supports creative reasoning by providing timely feedback closely connected to the students' activities.

Keywords: Dynamic software, mathematical reasoning, problem solving.

Even though studies has shown that creative reasoning is more efficient for learning than imitative reasoning (Jonsson, Lithner, Norqvist, & Liljekvist, 2014) there is a wide range of research reporting that regular teaching is guiding students into imitative strategies (Hiebert & Grouws, 2007; Lithner, 2008). Lithner (2000) found imitative strategies are a main obstacle when students are solving tasks for which they don't know a solving method in advance. Imitative strategies are associated to imitative reasoning, IR, i.e., students are trying to recall remembered procedures and facts that are usable to solve the task. Creative mathematical reasoning, CMR, is characterized by creating new (for the student) solving methods supported by argumentation anchored in intrinsic mathematic components (Lithner, 2008).

The didactical situation of the study was designed to invite students to engage in CMR. Pairs of students were solving a task to which they didn't know a solving method in advance and there were no hints like, e.g. predicting outcome. They had access to dynamic software, GeoGebra. Features of dynamic software

like multiple synchronized representations (e.g., algebraic and graphic), immediate response, no explicit indications of right or wrong answer for specific tasks, have been suggested to support students' reasoning (Barwise & Etchemendy, 1998). The instructions of the tasks meant an intellectual challenge (Schoenfeld, 1985) and the students were responsible to create a solution method (Brousseau, 1997). Students working in pair have been found engaging in discussions and mutual explanations during problem solving (Mullins, Rummel, & Spada, 2011). Data were collected through screen- and video recordings. The main object of analysis was students' reasoning associated to their use of dynamic software. Lithner's framework of imitative and creative reasoning (2008) was used to categorize students' reasoning. The use of feedback was analyzed through Shute's theories of formative feedback theories (2008).

The study shows that GeoGebra supports CMR by providing neutral immediate feedback. The feedback becomes the object for students' evaluation and argumentation, the latter is an important component of CMR. Furthermore, students who predicted the outcome before submitting the algebraic formula used the given feedback to elaborate on their problem solving and engaged in CMR. Students that did not predict the outcomes solely used the feedback to state if they were right or wrong and by that merely engaged in IR.

The poster presentation will be made up of illustration and descriptions of the didactical design, examples of tasks used, method, CMR an IR-reasoning, and the results of the study.

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