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# Problem solving competency and the mathematical kangaroo

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*The goal of the study was to investigate differences in how two groups of students activated mathematical competencies in the mathematical kangaroo (MK). The two groups, group 1 and 2, were identified from a sample of 264 students (grade 7, age 13) through high achievement (top 20 %) in only one of the tests: the MK or a curriculum bounded test (CT). Analysis of mathematical competencies showed that the high achievers in the MK activated the problem solving competency to a greater extent than the high achievers in the CT, when doing the MK. The results indicate the importance of using non-traditional tests in the assessment process of students to be able to find students that might possess good mathematical competencies although they do not show it on curriculum bounded tests.*

**Keywords:** Problem solving, mathematical competency, alternative assessment.

## RESEARCH QUESTION

How can differences in students' strength in the problem solving competency be visualised through the mathematical kangaroo (MK)?

## THEORETICAL BACKGROUND

Teachers in Sweden have observed that some students achieve highly in the international competition, the MK, although they have trouble with the national courses in mathematics. Some teachers suspect that those students are highly able in mathematics (Mattsson, 2013). To investigate if differences in achievement between groups of students on the MK can be explained by mathematical competencies, Mathematical Competencies: a Research Framework (MCRF) (Lithner et al., 2010) is used as framework. The framework describes six mathematical competencies: applying procedures, representation, connec-

tion, communication, reasoning and problem solving (Lithner et al., 2010).

## METHOD

Empirical data is test results of same students' (n = 264) from the national test (CT) given in grade 6 and from the MK given in grade 7. Two groups of students were identified: *Group 1*, top 20% achievers in the MK but not in the CT, i.e. among the bottom 80% in the CT. *Group 2*, top 20% achievers in the CT but not in the MK. The two groups' activation of mathematical competencies on the MK was compared after eliminating the achievement factor. Competencies are therefore activated within an individual by showing the individuals' strengths and weaknesses. Each identified individual belonged to one of the two disjunctive groups, and differences between the groups were analysed.

## RESULTS AND DISCUSSION

This study verifies teachers' observation, that there are students who achieve among the top in the MK but not in the CT. It is shown that on the MK, *Group 1* activates the problem solving competency to a greater extent than *Group 2*. Some tasks (6 out of 21), in the MK differ more than others in response rate between the two groups. Those tasks have in common that they all give opportunity to activate either the problem solving (n = 5) or the reasoning (n = 5) competencies. The reasoning competency is in the MCRF closely related to the problem solving competency, it is its juridical counterpart (Lithner et al., 2010). This study shows that the MK consists of a relatively high number of problem solving tasks, the MK also aims to offer interesting challenges. The use of challenging problems are important when working with mathematically highly able students (Nolte, 2012), The MK has inspired part of a model used to identify students highly able in mathematics (Pitta-Pantazi, Christou,

Kontoyianni, & Kattou, 2011), maybe the students in *Group1* actually are mathematically highly able and given challenging mathematical problems makes them achieve. This study indicates that through the MK some students show good mathematical competencies that they not are able to show on the national test. It is therefore important to use both curriculum bounded test as well as non-curriculum bounded in assessment, so that students get more and varying possibilities to show their strength.

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