Difficult to read or difficult to solve?

The role of natural language and other semiotic resources in mathematics tasks

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Abstract

When students solve mathematics tasks, the tasks are commonly given as written text, usually consisting of natural language, mathematical notation and different types of images. This is one reason why reading and interpreting such texts are important parts of being mathematically proficient, at least within the school context. The ability utilized when dealing with aspects of mathematical text is denoted in this thesis as *a mathematical reading ability*; this ability is useful when reading mathematical language, for example, in task text. There is, however, a lack of knowledge of what characterizes this mathematical language, what students need to learn regarding the mathematical language, and exactly which mathematical language that tests should preferably assess. Therefore, the purpose of this thesis is to contribute to the knowledge of aspects of difficulty related to textual features in mathematics tasks. In particular, one aim is to distinguish between a difficulty that has to do with a mathematical ability and another that has not. Different types of text analyses are utilized to capture textural features that might be demanding for the students when reading and solving mathematics tasks. Aspects regarding vocabulary are investigated both in a literature review and in a study where corpora are used to analyse word commonness. Other textual analyses focus on textual features that concern mathematical notation and images, besides natural language. Statistical methods are used to analyse potential relations between the textual features of interest and both task difficulty and task demand on reading ability. The results from the research review are sparse regarding difficult vocabulary, since few of the reviewed studies analyses word aspects separately. Several of the analysed textual features are related to aspects of difficulty. The results show that tasks with more words that are uncommon both in a mathematical context and in an everyday context, may favour students with good reading ability rather than students with good mathematical ability. Another textual feature that is likely to be demanding for students, is if the task texts contains many meaning relations, for example, when several words refer to the same or similar object. These results have implications for the school practice both regarding textual features that are important from an educational perspective and regarding the construction of tests. The research does also contribute to an understanding of what characterizes a mathematical language.