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Analysis of textbook modelling tasks, in light of a modelling cycle

Ingeborg Katrin Lid Berget
Volda University College, Norway; bergeti@hivolda.no

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Introduction

Even if the focus on mathematical modelling in education has increased the last decades, the presence of modelling activities in day-to-day teaching is still limited (Frejd, 2012). This study concern classroom practices comprising mathematical modelling. It is a part of a project, which involves more studies of classroom modelling activities. In this study, we analyze modelling tasks in Norwegian mathematics textbooks evaluating their potential to develop students modelling competency. The tasks are analyzed using the modelling cycle from Blum and Leiβ (2007).

Theory

Modelling competency is defined as “being able to autonomously and insightfully carry through all aspects of a mathematical modelling process” (Blomhøj & Højgaard Jensen, 2003, p. 126). In line with other definitions of modelling competency, the process is essential. The modelling process is often visualized by a cycle. The cycle by Blum and Leiβ (2007) sees modelling from a cognitive perspective. This is relevant for this study, which focuses on students’ possibility to evolve modelling competency by solving textbook tasks. The seven steps in the modelling process described in this modelling cycle is 1) Construct, 2) Simplify, 3) Mathematise, 4) Working mathematically, 5) Interpret, 6) Validate and 7) Expose. The steps are operationalized as shown in Figure 1. The study is guided by the research question: Which steps of the modeling cycle are requested for solving textbook modelling tasks?

Method

Because of the link between the modelling competency and the modelling cycle, it is relevant to make each of the steps a category for the analysis. To identify the categories, identifying questions were made to each modelling step. An example is given, and the identifying questions are presented in Figure 1. The questions are answered in the analysis of the task in Figure 1. This shows that this task only requires step 4, 5 and 6 to be solved.

![Figure 1: A typical textbook modelling task, and questions to identify the seven steps](image-url)
Most of the textbook tasks have several sub-questions, as the task in Figure 1. For more open tasks ‘validate’ was operationalized by the identifying question “Does the task have a given correct answer?” If a correct answer is given, there is no need for validation. The textbooks are from the subject Mathematics 2P (practical mathematics) in second year of upper secondary school (age 17-18). The curriculum recognizes modelling providing an overarching perspective to mathematics, and modelling is one of four main subject areas. The analyzed sample consists of all tasks in the modelling chapters, a total of 514 tasks from the three most used textbooks in this subject.

**Results**

![Table 1: Results](image)

The result shows that step 1, 2 and 3 are only requested in 3 of the 514 tasks. If the textbook authors have already constructed and simplified the problem, there are no need for the student to expose the answer by explaining which simplifications are done. The first two and the last step are connected.

**Discussion and concluding remarks**

The results show that the understanding of mathematical modelling within the textbook tasks are different from the theory used in this analysis. The tasks are from the chapters of the books named modelling. Even if the curriculum states that the starting point in a modelling process is something that actually exists, only 17 of the 514 tasks request mathematizing. Even if 292 of the tasks are formulated in a context, most of them are already mathematized. The tasks are formulated using mathematical language, and numbers are given, as in the task in Figure 1. More studies are needed to say if this understanding of mathematical modelling also is current in the classrooms.

Even if mathematical modelling is one of the four main subject areas in the subject Mathematics 2P, this study shows that working with the textbook tasks of the subject do not provide modelling competency. The starting point for the tasks is often step 4) working mathematically, and not 1) construct the problem from “something that actually exists”, as formulated in the curriculum.

**References**

