A CONTENT FOCUSED TASK SCHEMATIZATION AROUND MATHEMATICAL MODELING PROBLEMS: QUANTITIES

Ayse Ozturk
The Ohio State University
ozturk.25@osu.edu

Keywords: Number Concepts and Operations, Modeling, High School Education

Researchers have developed design categories or classification schemes for modeling problems (Bock, Bracke, & Kreckler, 2015; Czocher, 2017; Maaß, 2010) to make appropriate task choices for the target group of students and mathematical objectives. The task design around mathematical modeling needed to be carefully studied to evoke students' modeling process so that those processes could be traced systematically (Albarracin, Arleback, Civil, & Gorgorio, 2019). The goal of this study aimed to provide a task classification system to examine secondary students' modeling behaviors and decision-making processes while they are engaged in mathematical modeling tasks that draw on the content of Quantities.

The choice of mathematical content for this work was deliberate for two reasons: (1) the content of Quantities under the Number and Quantity section (CCSSM, 2010) plays a foundational role in the development of advanced mathematical domains (e.g., algebra, functions, vectors); and (2) the content naturally implicates to study modeling since it requires choosing, interpreting quantity units, and defining appropriate quantities to create descriptive models while coordinating both mathematical and non-mathematical knowledge to solve problems.

National and international research resources were reviewed to compile a list of modeling tasks (85 tasks). Two task design heuristics were followed in this project. First, by adopting Maaß's (2010) modeling task design framework, I examined modeling tasks under the five categories: the scope of modeling (whole process or sub-process), the amount of data provided (superfluous, inconsistent, missing, matching), the nature of the task's relationship to reality (level of authenticity or artificiality), the contextual situation (personal, occupational, public, scientific), and the type of model used (descriptive or normative). I used these categories along with the target mathematics content. Second, following Czocher's (2017) task selection method, the modeling cycle (Blum & Leiß, 2007) was utilized to filter the tasks from the list in order to map each task with the anticipated stages and transitions of the modeling expected to be evoked.

The final list of modeling tasks (14 tasks) was evaluated and critiqued by a panel of mathematics educators and field-tested by two researchers in high school classrooms. The tasks ranged from targeting specific steps to whole steps of the modeling cycle (Blum & Leiß, 2007) to study closely how secondary students might move between mathematical modeling stages and how their cognitive resources might influence their problem-solving process. This task scheme can be used for identifying modeling problems for the use of one-on-one clinical interviews or implemented in classrooms for tracking the kinds of mathematical thinking among high schoolers.

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