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Promoting Engineering Students' Mathematical Modeling Competency

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School mathematics instruction has created a view among students of mathematics as tedious, abstract, and unrelated to the real world. Increasing numbers of researchers in mathematics education are concerned about the negative perspectives of students toward mathematics. They suggest the use of real-world problems in math class to link the world of mathematics with the real world. More teachers and researchers, such as Lesh and Doerr [1] and Burkhardt [2], agree that mathematical modeling is an important aspect of math education. Over the past ten years, it has become increasingly important to apply mathematics to other subjects, including engineering, nanotechnology, economics, and biology. This study aims to design mathematical modeling activities, based on models and modeling perspectives and embedded into calculus courses, to develop students' mathematical modeling competency. Teaching experiments in this study used the island approach proposed by Blum and Niss [3] to integrate model-based teaching activities into formal activities for teaching calculus, and is used to avoid resistance from students who are used to traditional teaching. The ultimate purpose of the teaching experiments is to foster students' modeling competency through a modeling process. By implementing such teaching experiments, we investigate the mathematical modeling process and competency of first year engineering students, which can be used as a reference for designing activities for teaching mathematical modeling to college students.

RESULTS

Figure 1 shows the mathematical modeling competencies in each transition (cognitive activity) that were identified in this implementation of the task. Each element has two parts where key (generic) categories in the transitions between phases of the modeling cycle are indicated (in regular type), and illustrated (in capitals) with reference to the task.

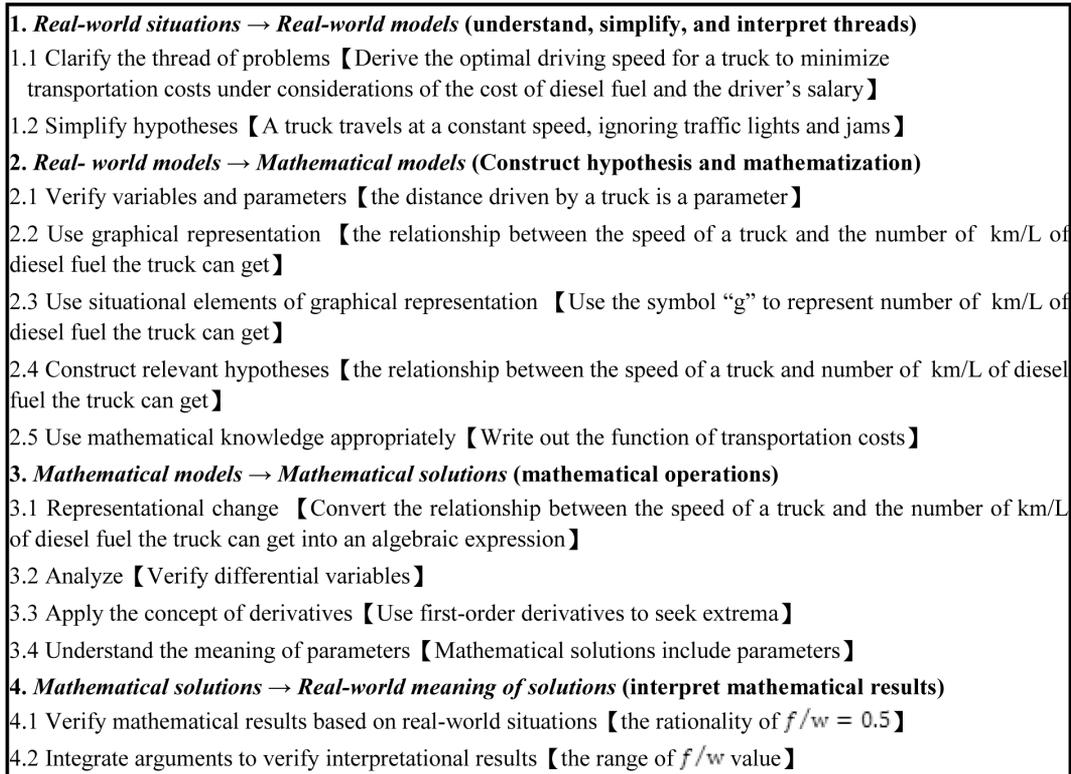


Figure 1. Framework showing transitions and mathematical modeling competencies in the implementation of transportation costs activity.

This study replaced extreme problems in calculus courses with the mathematical modeling activities of reducing transportation costs. Through mathematical modeling instruction, students can gradually develop their mathematical modeling competency by working on their own and through discussion with their peers. The analysis results of research data show that a fundamental and important problem encountered by students is their failure to recognize variables, parameters, and constants; and whether these values are known or unknown, obscure or clear, or independent or related. Therefore, the insufficient ability of students to categorize variables, parameters, and constants should not be ignored. Educators should help students in establishing useful relationships required by mathematical problems. ■

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