

Abstract

Developing students' statistical thinking has been stressed as an important learning objective for statistics courses. In general, statistical thinking has been defined as "thinking like an expert applied statistician." However, there is currently no consensus on the characteristics that make up statistical thinking. In addition, there is no known assessment that measures the complete construct of statistical thinking.

The purpose of this study was to assess students' statistical thinking in an introductory statistics course that is based on modeling and simulation. Specifically, the research question of interest was *what components of students' statistical thinking are revealed and developed in an introductory course that is based on modeling and simulation?* To assess this, an assessment was created, called Modeling to Elicit Statistical Thinking (MODEST), that was based on a model of statistical thinking and utilized a type of problem that has been suggested to assess expert-like thinking (i.e., a Model-Eliciting Activity; MEA). To try to ensure that MODEST was an assessment of statistical thinking, several phases of feedback and pilot testing were carried out during the assessment development phase.

In the field test phase, MODEST was administered online twice, at the beginning and at the end of the semester, to students enrolled in an introductory course that is based on modeling and simulation. Responses from 88 students were scored using a detailed scoring rubric to answer the research question. The results indicated that students appeared to enter the course with a moderate amount of statistical thinking (average score = 52%) and leave having developed some statistical thinking as a result of the course

(average score difference = 6%; 95% CI: 2% to 10%). Even though the increase in their overall statistical thinking was significant, it was moderate (Cohen's $d = 0.34$). Based on this, it appears that more could be done in the course to increase students' statistical thinking.

MODEST can be a valuable addition to the statistics education community by filling in the gap of assessing students' statistical thinking. Both statistics education researchers and instructors would benefit from using MODEST to understand statistical thinking.