A Longitudinal Investigation of the Development of College Students' Reasoning About Bivariate Data During an Introductory Statistics Course

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ABSTRACT

Reasoning about bivariate data, or covariational reasoning, has been identified as important to develop in introductory statistics students. With more students taking introductory statistics classes than ever before, it is important to evaluate how covariational reasoning develops, as well as the factors that might influence that development.

This study examined students' development of reasoning about quantitative bivariate data during a one-semester university-level introductory statistics course. There were three research questions of interest: (1) What is the nature, or pattern of change in students' development in reasoning about bivariate data?; (2) Is the sequencing of bivariate data within a course associated with changes in the pattern of change in students' reasoning about bivariate data?; and (3) Are changes in students' reasoning about the foundational concepts of distribution associated with changes in the pattern of change in students' reasoning about bivariate data?

To measure change in students' reasoning, a scale from the Assessment Resource Tools for Improving Statistical Thinking (ARTIST) project was administered to 113 students in four sections of a course, four times during the semester. Students' distributional reasoning was also assessed four times during the course using ten items from the Comprehensive Assessment of Outcomes in a First Statistics course (CAOS). To examine the association between course sequencing and the patterns of change in students' reasoning about bivariate data, the two instructors of the course were used as blocks to randomly assign each section of the course to one of two different sequences.

Data were analyzed using linear mixed-effects model (LMM) methodology. The results of the different LMM analyses suggested that students tend to exhibit both linear and quadratic rates of change in their development of covariational reasoning.

They also suggested that the instructional sequence (topic placement within a course) was not statistically significant in explaining those rates of change. There was, however, some evidence that students' change in reasoning about univariate distribution was significantly positively related to the quadratic rate of change in reasoning about bivariate data.