ABSTRACT

Research has shown that even if a student passes a standard introductory statistics course, they often still lack the ability to reason statistically. This is especially true when it comes to reasoning about variability. Variability is one the core concepts in statistics, yet many students come away from introductory course unable to discuss basic ideas of variability or make the connection between graphical displays of data and measures of variability.

This study investigated students' conceptual understanding of variability by focusing on two numerical measures of variability: standard deviation and standard error. Two sections of introductory statistics were taught at a small Midwestern liberal arts college. One section was taught with standard lecture methods for the topics of standard deviation, sampling distributions and standard error, and confidence intervals and the margin of error. The other section completed a hands-on active learning lab for each these topics. These labs were designed with a conceptual change framework. Students were asked to use their prior knowledge to make predictions, collect and analyze data to test their predictions, and then evaluate their predictions in light of their results. Assessment questions designed to test conceptual knowledge were included at the end of each lab.

Both classes completed the Comprehensive Assessment of Outcomes in a first Statistics course (CAOS) as a pretest and a posttest. The assessment questions from the active learning labs were analyzed and coded. And small number of students from each section also participated in twenty-minute interviews. These interviews consisted of statistical reasoning questions.

The analysis of the data showed students' conceptual understanding of ideas related to standard deviation improved in the active class, but not in the lecture class. There was no evidence of improvement on the topic of standard error in either class and some evidence that students had regressed in both sections. The analysis of the qualitative data suggests that understanding the connection between data distributions and measures of variability, and understanding the connection between probability concepts and variability is very important for students to successfully understand standard error. There is also evidence that students come to an introductory statistics course with more conceptual knowledge related to sampling distributions than was previously thought. There is evidence that the feedback portion of hands-on active labs is the most important feature of the conceptual change framework. Further research is needed to investigate how much prior knowledge students possess about sampling distributions and how important probability concepts are to understanding concepts of variability.