The Effects of Graphing Calculator on Learning Introductory Statistics

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Abstract: Graphing calculators have been used for teaching introductory statistics for decades. They helped students to obtain accurate statistical analysis results. However, heavily relying on graphing calculators may hinder students’ understanding of certain statistical concepts such as the normal distribution and p-value. In this study, we focused on the effects of using a graphing calculator on students’ conceptual understanding of normal distribution and p-value, and their performance of calculating normal probabilities and conducting a hypothesis test.

Methods

This study included four sections of an introductory statistics course from two instructors. Each instructor taught one section with the use of graphing calculator and another section without graphing calculator. The goal was to test if the average grade was significantly higher from the graphing calculator section (referred to as TI section) than that from the section without using graphing calculator (referred to as non-TI section).

Two quizzes and three final exam questions were included in this study. Quiz one contained one multiple choice question of the conceptual understanding of standard normal transformation, and one calculation question covering the normal probabilities. Quiz two contained one multiple choice question of the conceptual understanding of p-value, and a short answer question covering a hypothesis test of difference in proportions. The three final exam questions were used to test on retention, including two multiple choice questions of the concepts of standard normal transformation and p-value, and a calculation question of hypothesis testing of a single mean. Each quiz was given to both the TI section and non-TI section at the same time.

Mantel-Haenszel analyses were used to analyze the multiple choice questions and 2 by 2 ANOVAs with two independent factors, instructor (instructor one and instructor two) and the use of calculator (TI and non-TI), were used to analyze short answer questions.

Results

The Mantel-Haenszel analysis for quiz one multiple choice question showed that the proportion of correctness was significantly higher for the TI section than that for the non-TI section when testing on the conceptual understanding of standard normal transformation. The Mantel-Haenszel analysis for quiz two multiple choice question showed that there was no significant difference in proportions of correctness between the TI and non-TI sections when testing on the conceptual understanding of p-value. The 2 by 2 ANOVA of quiz one calculation question showed that the average score was significantly higher for the TI section than that for the non-TI section when students did the calculation of normal probabilities. The 2 by 2 ANOVA of quiz two short answer question showed that the average score was also significantly higher for the TI section than that for the non-TI section on performing hypothesis testing. All of the Mantel-Haenszel analyses and 2 by 2 ANOVAs of the final exam questions did not show significant differences between the TI and non-TI sections for retaining the knowledge of standard normal transformation, normal probability calculations, p-value and hypothesis testing.
References


