Comparing student understanding of valid and invalid statements of confidence intervals, pre- and post-course

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Introduction

Statistical literacy is an essential skill for many academic disciplines. Many students have difficulty in introductory statistical courses and struggle to grasp fundamental statistical concepts due to the subject's complex nature. Differences in pedagogical approaches may influence students' ability to understand these concepts. Simulation-based inference (SBI) curricula, which focus on re-sampling and re-randomization instead of theoretical probability distributions, show a more intuitive understanding than traditional statistical curricula. We want to investigate whether different curriculum approaches have impacts on students' ability to understand confidence intervals.

Methods

Our research utilizes a national, multi-institutional dataset that contains pre- and post-measures of students' responses. The dataset aims to evaluate attitudes and conceptual understanding of different statistical concepts. To compare the different statistical curricula, we narrowed our research focus on asking students to identify valid and invalid confidence interval interpretations. Out of the three interpretations, only one was correct. We separated the responses by textbook to continue the analysis.

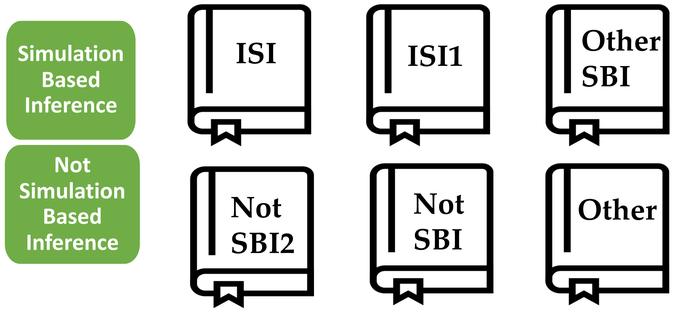
Survey Questions:

Q.18 We can infer with 95% confidence that a randomly selected cookie manufactured for this generic brand will weight between 25.65 to 26.35 grams.

Q.19 **We can infer with 95% confidence that mean weight of all cookies manufactured for this generic brand is between 25.65 and 26.35 grams.**

Q.20 We can infer with 95% confidence that the average weight for 50 cookies randomly selected from those manufactured for this generic brand will be between 25.65 and 26.35 grams.

Textbook Classification:



Results

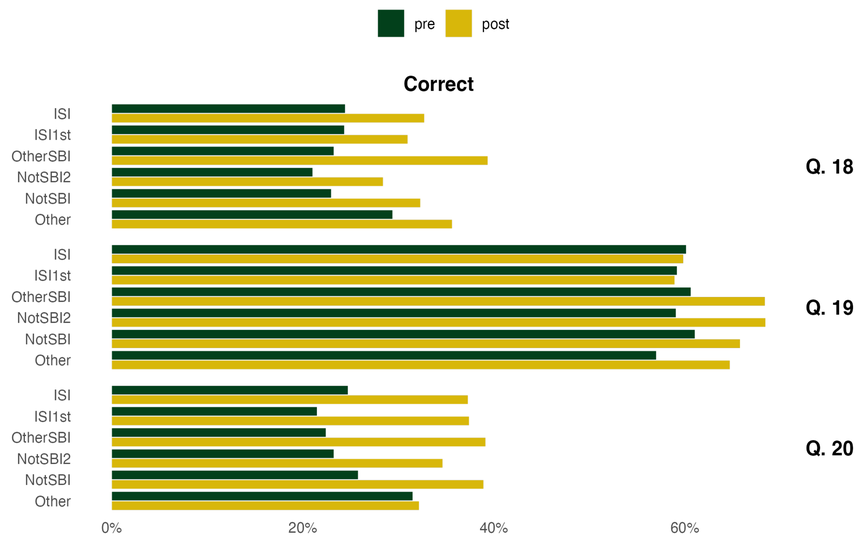


Figure 1: Comparing the pre and post percentages for the correct responses with each textbook for questions 18, 19, and 20.

	ISI	ISI1st	Other SBI	Not SBI	Not SBI2
CCC	0.111	0.102	0.168	0.127	0.105

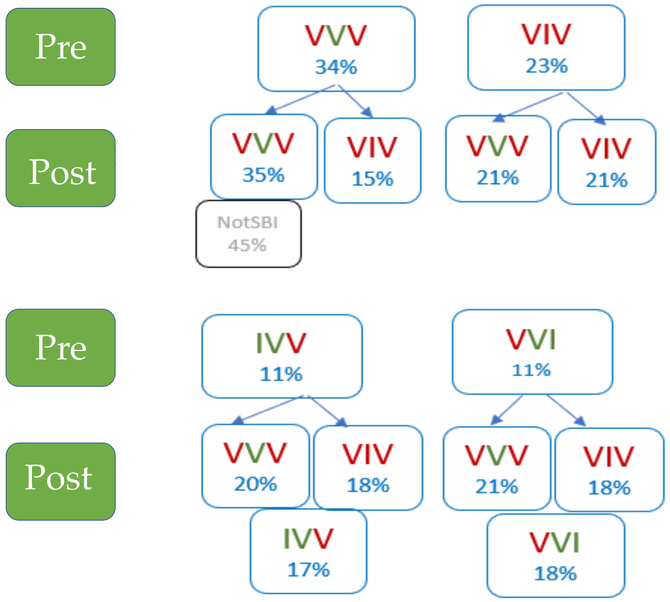


Figure 2: Comparing most common combinations of valid and invalid answers for post-course scores after taking account the common answers of pre-course scores.

Discussion

The results of the looking at the bar graph show that there was greater improvement for questions 18 and 20. Question 19 had a higher percentage correct for pre and post for each textbook. More students were able to recognize the valid confidence interval interpretation than to correctly identify the invalid interpretations. There was not much difference between the SBI and non-SBI textbooks when comparing pre and post results. There was some difference between the ISI and other SBI textbooks when comparing pre and post results.

From the results of looking at the most common combinations of invalid and valid answers from pre and seeing how post was affected, we gained insight that there was not much difference between the six textbooks. We found the more students changed to a correct to an incorrect answer or either stay the same for questions 18 and 20, than to switch to the correct answer for post. The questions were resistant to change as it was difficult for students to not see question 18 and question 20 as valid, when these questions were in fact the invalid confidence interval interpretations. Question 19 was the only valid confidence interval interpretation, and it seemed from the post results students were able to recognize this fact.

Next Steps

Future analysis of comparing textbook results should dive deeper into looking at other factors that might show difference between the pre and post responses. Other pre- and post-measures were recorded from the dataset such as student's attitudes towards statistics and whether they have taken a statistics course before. These measures could be influencing the student's ability to comprehend fundamental concepts. It could be of interest to look at other statistical concepts where students tend to struggle and compare the pre and post measures based on the textbooks since confidence intervals tend to be a difficult concept many struggle to understand.

References

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Marjorie E. Bond, Susan N. Perkins, & Caroline Ramirez (2012) Students' Perceptions of Statistics: An Exploration of Attitudes, Conceptualizations, and Content Knowledge of Statistics, DOI: https://doi.org/10.52041/serj.v11i2.325

Acknowledgments

We would like to thank Dr. Chance for her involvement and help in this research. We appreciate the time she took to help support us through the research. We would also like to thank the Dr. Schaffner for allowing us to continue this research through our coursework and enrollment in STAT 400.