

Abstract

This doctoral work discusses three projects which jointly consider assessment, improvement, and the underlying measurement of contextualized statistical literacy. The central role of statistical literacy has been discussed extensively in the statistics education literature [1–15], emphasizing its importance as a learning outcome and in promoting a citizenry capable of interacting with the world in an informed and critical manner. However, little is known about the influence on student learning outcomes associated with student perceptions about context choices (e.g., application domain) in classroom examples, assessment tasks, etc. Therefore, research which can inform and improve the practice of statistics education is of paramount importance.

The first project in this work assessed the level of contextualized statistical literacy - statistical literacy vis-a-vis contexts with personal relevance or significance to the students. Specifically, the context of the ongoing COVID-19 pandemic was considered. Towards this goal, an isomorphic assessment of an existing research-based instrument was developed and piloted. Data from the pilot study were analyzed to compare psychometric properties of the original and the modified assessment, as well as to consider test-takers' responses to these assessments in relation to various respondent demographics, survey responses, and item characteristics.

The second project employed statistical methods for causal inference to analyze data from a curricular experiment. This experiment was designed and implemented with the aim of improving the level of contextualized statistical literacy. It was conducted in a coordinated undergraduate introductory statistics course taught at a large research

university on the east coast of the United States. Pre-test and post-test scores were collected using the assessment instruments discussed in the first project.

The third project was an application of the Cognitive Diagnostic Modeling (CDM) framework. In addition to being one of the first applications of CDM to statistics education, statistical problem-solving being an inherently more complex cognitive task [16] makes this work a novel contribution. The project outlined the cognitive skills underlying statistically literate behavior as measured by the assessment instruments in the first project. Specifically, data from the pilot study were analyzed to investigate whether a context familiarity skill plays a role in respondents' ability to answer items pertaining to relevant contexts correctly. A Q-matrix specifying the skills needed to answer each item correctly was developed in order to analyze data using CDM models.

This work contributes to methodological advances which can support future statistics education research, through a substantive topic of statistical literacy. It demonstrates 1) the development of an isomorphic assessment, 2) design and implementation of a randomized curricular experiment, 3) estimation and interpretation of causal effect of a curricular treatment on the intended outcome measured through a research-based assessment, and 4) application of CDM to a problem in statistics education including the formation of a Q-matrix. This work can inform both research and practice in statistics education, thereby benefiting students of statistics.