Developing Undergraduates' Critical Statistical Literacy through the Use of Online Discussion Boards

Nina Bailey, Faculty Advisor: Allison W. McCulloch

UNC CHARLOTTE

RESEARCH PURPOSE

Explore how students express *Critical Statistical Literacy* skills within online discussion forums used to supplement a face-to-face introductory statistics course at the undergraduate level.

BACKGROUND

While there is no consensus on the elements of statistical literacy, the literature reveals consistent emphasis on understanding the basic terminology and concepts, understanding the need for and generation of data, interpreting different representations and conclusions, and acknowledging the potential for data to generate conflicting interpretations (e.g., delMas 2002; Gal 2002; Garfield and Ben-Zvi 2007; Rumsey 2002).

Other researchers have detailed how to assess statistical literacy (e.g., Budgett & Pfannkuch, 2010), developed hierarchical frameworks (e.g., Watson & Callingham, 2003), and described curriculum design or reform (e.g., Schield, 2004; Tishkovskaya & Lancaster, 2010).

CRITICAL STATISTICAL LITERACY

The practice of analytically examining and assessing statistical content to inform action or change.

PARTICIPANTS & DATA COLLECTION

Participants: 8 Introductory Statistics students
Context: Required introductory statistics course within a Gender Learning Community at a small south east university
Data sources: Class discussion board posts and responses to 6 different prompts containing popular media

CONCEPTUAL FRAMEWORK: CRITICAL STATISTICAL LITERACY

Framework is adapted from Gal's (2002) "Worry Questions." Gal describes beliefs, attitudes, and critical stance as playing a vital role in moving from passive interpretation to informed action.

CRITICAL STANCE: WORRY QUESTIONS (GAL, 2002)

"Where did the data (on which this statement is based) come from? What kind of study was it? Is this kind of study reasonable in this context?" "How reliable or accurate were the instruments or measures (tests, questionnaires, interviews) used to generate the reported data?"

Bias → Demonstrates a questioning attitude towards statistical information that may be misleading, one-sided, biased, or incomplete in some way

"Was a sample used? How was it sampled? How many people did actually participate? Is the sample large enough? Did the sample include people/units which are representative of the population? Is the sample biased in some way? Overall, could this sample reasonably lead to valid inferences about the target population?"

Sample → Questions the sample size, sampling methods, or lack of Information regarding the sample

"Should additional information or procedures be made available to enable me to evaluate the sensibility of these arguments? Is something missing? e.g., did the writer "conveniently forget" to specify the base of a reported percent-of-change, or the actual sample size?"

Additional → Demonstrates a need for additional information to make inferences

"Are there alternative interpretations for the meaning of the findings or different explanations for what caused them, e.g., an intervening or a moderator variable affected the results? Are there additional or different implications that are not mentioned?"

Alternate → Acknowledges the potential for alternative interpretations or conclusions or alternate explanations for what caused it

"Are the reported statistics appropriate for this kind of data, e.g., was an average used to summarize ordinal data; is a mode a reasonable summary? Could outliers cause a summary statistic to misrepresent the true picture?"

Appropriate → Questions whether the type of statistics is the most appropriate for the data

OPERATIONALIZATION OF CSL

ELEMENTS OF CSL ELICITED: EXAMPLES

"I was at first hesitant to take all of the information in these visuals at face value as it looked like only a few data points were labeled, but I soon discovered that each point could be scrolled over and its information revealed. I would say that my hesitation in this case might have come from our learning to be critical of statistics from this class, including the video we watched on faulty."

"It is important to know various details about how the study was conducted and on whom. Knowing these details is important to determining if study results may or may not be valid."

"We need to know when this drop off is happening, what age the wage gap begins to widen because in the early ages of work men and women are getting almost fair salaries. Finally, we need to know why wage gaps are so wide, what does comparing all of these statistics show?"

The author "doesn't take into consideration the different ages or different fields the men and women are in."

"I believe that if we are looking at the wage gap, it should be accessed by job to job. I think male and female salaries should be compared within the same job. Both of them are performing the same job and doing the same work. I also think two separate studies should take place with one being with people working full time and then another being with people working part time."

FINDINGS

The results indicate that the majority of students (75%) exhibited *critical* statistical literacy across all discussion prompts.

CSL: EMERGING ELEMENTS

Previous Knowledge or Experience — Infusion of the students' previous knowledge or experience

"Our Gender and Social Experiences QLC textbook, "Gendered Worlds" (Aulette & Wittner) offers some data surrounding the gender wage gap. One of the ways the gap is demonstrated in the book is through a table on page 185 that displays the pay difference among various genders, races, and levels of education. This table demonstrates the theory of intersectionality, meaning loosely that all issues in gender are in some way interconnected and can be viewed from multiple perspectives."

Active Citizenry — Social awareness of inequities and motivation for action to improve inequities

"I believe that if we are looking at the wage gap, it should be accessed by job to job. I think male and female salaries should be compared within the same job. Both of them are performing the same job and doing the same work. I also think two separate studies should take place with one being with people working full time and then another being with people working part time."

PROPORTION OF PROMPTS CONTAINING CSL BY STUDENT

Student	Bias	Sample	Additional	Alternate	Appropriate	Previous Knowledge/ Experience	Active Citizenry
Derek	0.3	N/A	0.2	0.2	N/A	0.2	0.7
Kylie*	0.6	N/A	0.2	0.2	0.4	N/A	0.8
Payton	0.5	0.2	0.2	0.7	0.3	0.3	0.8
Naomi	0.7	0.2	0.3	N/A	N/A	N/A	1.0
Destiny	0.3	N/A	0.7	0.5	N/A	0.3	0.5
Jessica	0.2	N/A	N/A	N/A	N/A	N/A	0.5
Charlotte	0.3	N/A	0.3	N/A	N/A	0.2	0.8
Hope*	N/A	N/A	0.4	0.6	N/A	N/A	0.8

Note: * indicated that the student only completed 5 of the 6 prompts. N/A indicates that the student did not participate in the prompt.

DISCUSSION

- Watson and Callingham (2004) called for increased opportunity to engage in critical statistical literacy, and the results of this study suggest that online discussion boards using a variety of open-ended prompts with popular media and articles can provide such opportunities.
- Abundance of instances where students demonstrated the use of CSL to highlight the need to become a more active citizen points to the potential that discussions boards have to:
  (1) bolster engagement,
  (2) increase interest, and
  (3) stimulate reflective thinking
- Recommend that introductory statistics courses provide students with opportunities to explore data and discuss topics that increase awareness of inequity.

FUTURE STUDIES

Further investigation is needed to
- determine if prompts that elicit more evidence of active citizenship correlate with increased student engagement.
- determine if student interest is elevated by the use of specific prompt types or media types.
- determine if time plays a role by changing the order of prompts, perhaps across multiple classes.

References

Budgett, S., & Pfannkuch, M. (2010). Assessing students' statistical literacy. *Assessment methods in statistical education: An international perspective*, 103-121.
delMas, R. C. (2002). Statistical literacy, reasoning, and thinking: A commentary. *Journal of Statistics Education*, 10(2).
Gal, I. (2002). Adults' statistical literacy: Meanings, components, responsibilities. *International statistical review*, 70(1), 1-25.
Garfield, J., & Ben-Zvi, D. (2007). How students learn statistics revisited: A current review of research on teaching and learning statistics. *International statistical review*, 75(3), 372-396.
Rumsey, D. J. (2002). Statistical literacy as a goal for introductory statistics courses. *Journal of Statistics Education*, 10(3).
Schield, M. (2004). Statistical literacy curriculum design. *IASE Curriculum Design Roundtable. See www. StatLit. org/pdf/2004SchieldIASE. pdf*.
Watson, J. M., & Callingham, R. A. (2004). Statistical literacy: From idiosyncratic to critical thinking. *Curricular Development in Statistics Education. International Association for Statistical Education (IASE) Roundtable, Lund, Sweden*, 116-162.