Anomalous Graph Data and Claim Revision During Argumentation

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Abstract: The discourse practice of scientific argumentation requires individuals to consider anomalous data in light of existing claims that have been made. The extent to which students must be taught to revise their claims has been a subject of disagreement in the literature. In this poster, we use correlations and transcript excerpts to examine the relationship between the physical presence of referenced data and students' willingness to respond to anomalous data by revising their claims.

Introduction

Scientific argumentation is seen as an important disciplinary discourse practice for students of science because it facilitates students' collaborative sensemaking (Duschl, Schweingruber, & Shouse, 2007). However, it rarely occurs in science classrooms (Driver, Newton, & Osborne, 2000). One challenge facing students as they engage in this complex practice rests in their response to anomalous data. In particular, when presented with anomalous data, students reinterpret the data to align with their original claims rather than revising them (e.g., Kuhn, 1989). This suggests that students will not successfully use scientific argumentation as a context for collaborative sensemaking. Instructionally, this implies that students must be explicitly taught to reconcile their initial claims with anomalous data so that they can learn from argumentative interactions. However, other researchers (e.g., Engle & Conant, 2002) have witnessed students productively working with and incorporating anomalous data during argumentative discussions, without explicit instruction on how to do so. In addition, Hammer and van Zee (2006) have documented students as young as kindergartners "reconciling inconsistencies" when their personal theories contradict their observations of particular phenomena; the students they observed were quite capable of revising their claims in response to contradictory evidence.

The current study takes some initial steps towards reconciling these opposing observations by examining the context in which students are faced with and respond to anomalous data. We enter this study with the hypothesis that the source of the anomalous data will influence the students' responses to it. In particular, work such as Hug and McNeill (2008) demonstrates that students work with first- and second-hand data in very different ways. Thus, this poster focuses on whether and how the presence of the data (if it is something the students can see first-hand or if it is something that is reported to them by another individual) affects their response to and engagement with anomalous data.

Data Sources

The data for this analysis comes from video-recorded observations of a researcher-designed, 6th grade ecosystems unit (Finn et al., 2006) that was implemented in a self-contained classroom at a 100% African-American charter school. As part of the curriculum, students worked with a simulated ecosystem built in the NetLogo modeling environment (Wilensky, 1999). Toward the end of their work with NetLogo, pairs of students used NetLogo's dynamically generated population graphs to determine what organism in that simulated ecosystem (foxes, rabbits, or grass) was being eaten by an unknown invasive species. Following this, the pairs joined with another pair in the class. That foursome was then asked to agree on what the invader ate. Video recordings of two pairs and two foursome discussions were transcribed and analyzed for this current study.

Analytic Process

Data analysis consisted of a line-by-line examination of the students' evolving arguments about the model. We began by identifying instances in which students presented counter or anomalous evidence. We then coded the students' responses to that evidence. Based on the students' general tendencies, we identified 4 responses to the anomalous evidence: ignoring it, rejecting it, reinterpreting it so that it supported the original claim and revising the original claim. These correspond to a subset of the responses identified in Chinn and Brewer's study (1998). In addition, we coded for whether the students were discussing first- or second-hand data. Second-hand data included graphs individual students had observed earlier and were reporting to their group without showing them. First-hand data were visible graphs displayed on the simulation software; they were public objects that were physically present for discussion by the group. Coding of both the origins of the data and student responses to data was done in a binary fashion: an utterance was given a "1" or a "0" for whether each possible behavior (i.e., rejecting anomalous data, presenting first-hand data, etc.) was present in the utterance.

Once coding had been completed, un-coded utterances (typically involving content related to classroom management or digressions) were removed. This produced a large matrix of 1's and 0's. We used this matrix and devised a 'moving window' analysis in which we examined each turn of talk in combination with the four turns of talk that followed it. For each 'window' we calculated the total number of each possible discursive behavior present in the window. This moving window analysis was key to examining the relationship between the students' responses to anomalous data and the form of that data: the anomalous data was invariably presented by one student and responded to by another. Summing across a span of utterances enabled us to examine these interactions. Correlations were run on the 'moving window' sums, and passages with high moving window scores were revisited for further interpretive analysis.

Findings

This analysis reveals that utterances that involved first-hand data (i.e., "the population is dropping here in this graph") were positively correlated with student reinterpretation of anomalous data ($r = 0.224$; $n = 188$; $p < 0.005$). Moreover, there was a positive correlation between students discussing second-hand data (i.e., "when I did it earlier, the population dropped") and students rejecting anomalous data points ($r = 0.456$; $n = 188$; $r < 0.005$). For example, when one student pair was working with the model, Tyler said he had seen a graph earlier in which the rabbit population decreased (implying that the invasive species was eating rabbits), Kendra (who believed the invader ate grass) responded, "okay, I don't need to hear yo' story no more." In this, and similar instances, second-hand reports of data were dismissed or disregarded even if relevant to the current discussion. This suggests that students were more willing to discuss their various interpretations of data they could see than they were of data that one member was reporting.

In addition, there was a positive correlation between first-hand data and student revision of their claims ($r = 0.153$; $n = 188$; $p < 0.05$). For example, once directed toward first-hand data by his partner, Jonathan revised his claim: he began claiming that the invader ate grass and concluded that it ate rabbits and grass. In contrast there was a negative correlation between the students' second-hand reports of data they had observed and student revision of claims ($r = -0.218$; $n = 188$; $p < 0.005$). This suggests that students were more likely to find first-hand data compelling and revise their claims accordingly than they were with second-hand data

Discussion

Combining these relationships suggests that the context and materials present in the discussion influence the frequency with which students engage with and discuss contradictory data. In these classroom observations, we see that the presence of the data impacted whether students are more likely to engage with competing data points or to reject them out of hand. Thus, this paper suggests that students can and do revise their ideas in light of the evidence. That is, this is not a skill that they must be taught explicitly. It is, instead, something that we, as educators, must work to motivate by creating contexts in which it makes sense for students to substantively engage with the contradictory evidence. In this case, the presence of immediately accessible data seemed to positively influence this whereas second-hand reports of data appeared to have a limited observable influence.

Endnotes

(1) Both authors contributed equally and are listed in alphabetical order.

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