4-5-2019

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Asynchronous Discussions to Engage Students in Scientific Argumentation

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Background
Scientific argumentation is a practice of knowledge building which bridges claims and evidence. It plays an important part in understanding and execution of scientific knowledge (Duschl & Osborne, 2002) and is considered as one of the primary goals in science education (Duschl et al., 2007). Online discussion boards are becoming a common way to engage students in scientific argumentation. However, few studies of scientific argumentation in online environments have been conducted.

This study examines scientific argumentation occurring in an asynchronous online discussion board to answer the questions:
1. Does gender composition of discussion groups affect students’ engagement in productive scientific argumentation?
2. To what extent does gender composition of groups engaging in scientific argumentation influence the development of scientific literacy?
3. To what extent does gender composition of discussion groups and the quality of scientific argumentation affect students’ satisfaction with the discussion experience?

Methods
Participants were recruited from an online introductory biology course taught at a large R2 university in the Midwest United States during the summer of 2018. Students were placed in discussion groups that remained throughout the 6-week course. Students were assembled into 12 groups according to three gender treatments:
- all male (2 groups)
- all female (6 groups)
- mixed gender (4 groups)

At the beginning of the course, students’ scientific literacy was measured using 10 items from the TOSLS (Test of Science Literacy Skills; Gormally, Brickman, & Lut, 2012). Discussions occurring in week 5 of the course were downloaded, de-identified, and coded using the ASAC (Assessment of Scientific Argumentation in the Classroom) protocol (Sampson, Enderle, & Walker, 2012) to measure the quality of scientific argumentation. At the end of the course, 10 different but matched items from the TOSLS were administered, along with a survey of students’ satisfaction with their discussion experiences. A one-factor analysis of variance (ANOVA), using group composition to predict ASAC score, is planned to address the first research question, once more data are collected to increase the sample size of different group types. A repeated-measures ANOVA was used to assess the influence of group composition on pre/post-course growth in scientific literacy, measured by the TOSLS items, to answer the second research question. A two-factor ANOVA, using group composition and ASAC scores to predict satisfaction scores, was performed to answer the last research question.

Results
Figure 1. Mean scores on the ASAC protocol, which measures quality of scientific argumentation among students, across three different group types: All female groups, all male groups, and mixed gender groups. Error bars indicate standard deviations. Due to the low sample size of all male and mixed gender groups, statistical analysis could not be performed. However, data collection is still underway, and in the future, a one-way ANOVA will be performed to fully answer the first research question.

Figure 3. Relationships between quality of scientific argumentation, as measured by the ASAC protocol, and students’ satisfaction with the discussion experience, according to group type. Interestingly, there was a positive correlation between argumentation quality and satisfaction for students in all female groups but a negative correlation between these variables for students in all male groups. In mixed gender groups, there was no relationship. To check to see if this was simply a gender effect that was balanced in the mixed gender groups, we performed post-hoc regression analyses to examine how argumentation quality influences satisfaction in male vs. female students, which revealed the importance of group type. When not considering group type, there is little correlation for female students (y = 0.024x + 30.5, R² = 0.14) and no correlation for male students (y = -0.036 = 32.5, R² = 0.01).

Conclusions
All female groups demonstrated higher quality in scientific argumentation, but statistical analyses will be done after larger sample sizes are obtained. Pre/post course changes in scientific literacy decreased across all groups. Relationships between quality of scientific argumentation and students’ satisfaction with the discussion experience is positive for all female groups, negative for all male groups, and no relationship for mixed gender groups, revealing the importance of group type. When group type is not considered, there is only a small correlation for female students and no correlation for male students.

References

Acknowledgements
We thank the research participants for agreeing to participate in this study. The funding source for this study is the National Science Foundation (Award 1722213), which supports the ADESSA (Asynchronous Discussions to Engage Students in Scientific Argumentation) project.