

The influence of peer discussion on the quality of student written explanations

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Background:

Biology 260 is a second-year required physiology course in the Biology program

Class size of ~500 students into two sections

Assessment in **BIOL 260** is mainly exams (2 midterms and a final), for which students must provide short written explanations for their answers to conceptual questions.

Study rationale:

In BIOL 260, students often struggle to provide logically sound support for their answers to open-ended questions on exams

Numerous studies have shown that peer discussion aids in conceptual learning of course concepts

Study question:

Does peer discussion help students construct better logical arguments?

Study Design:

Section 1

Clicker question (1st poll)



Written explanation



Clicker question (2nd poll)

Section 2

Clicker question (1st poll)



Peer discussion



Written explanation



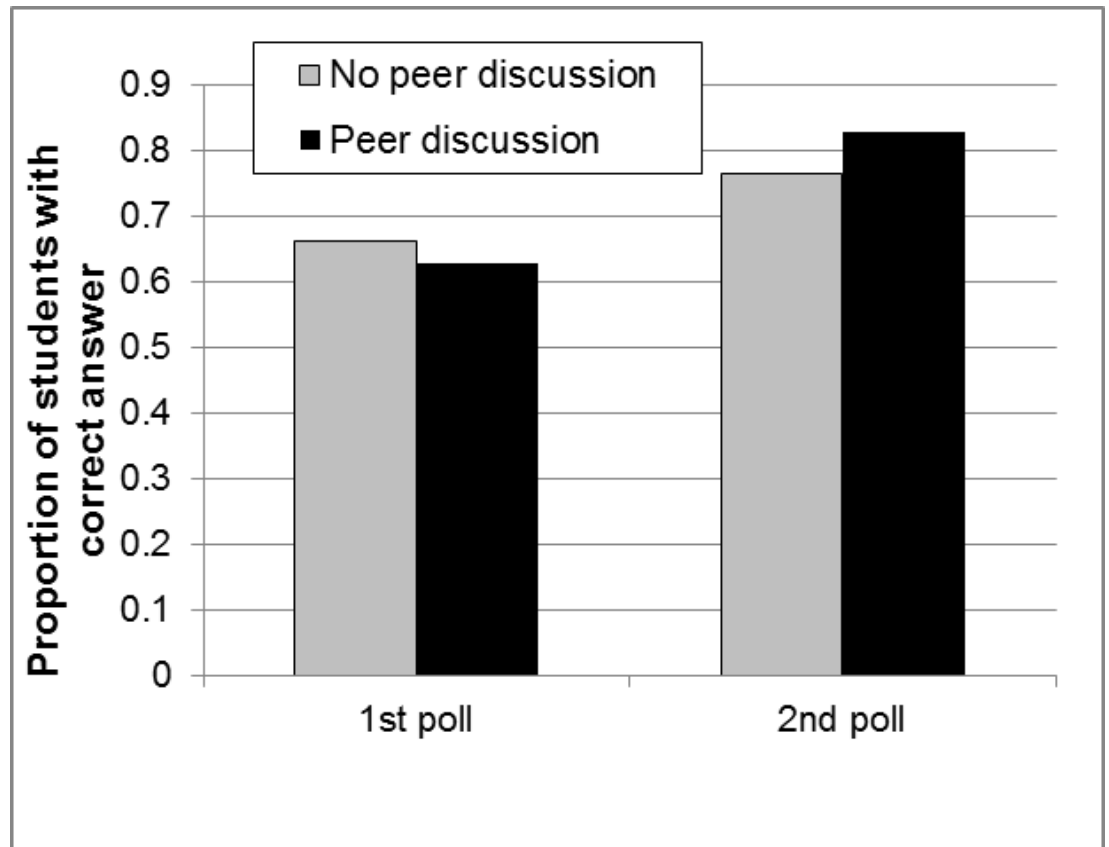
Clicker question (2nd poll)

Example Question:

A tree can grow from a tiny seed to a plant that has a dry mass of several thousand pounds. Where does the majority of this mass come from?

- a. The soil
- b. Water
- c. Air

Answer: c. Air



Marking Rubric for Explanation:

Arguments:

1. The dry mass of a tree is composed mainly of carbohydrates
2. Plants get carbohydrates from photosynthesis
3. Photosynthesis involves CO_2
4. The C and O in the carbohydrate comes from CO_2 (majority of mass of carbohydrate)

Other answer qualities:

- Contains misconception
- Contains superfluous information
- Correct, but not enough information/logical links for an educated novice to understand
- Misinterpretation of question

All components were scored for presence/absence

Examples of student answers:

“The majority of the mass comes from the air-> air is the biggest source of carbon, which is what a plant is primarily composed of.”

Argument grade: 2/4

“The majority of the plant mass comes from air. For one, the CO₂ in photosynthesis becomes the carbon and oxygen in plant sugars produced, which can serve as building blocks of plant structure. Carbon and oxygen make up the majority of the sugar weight.”

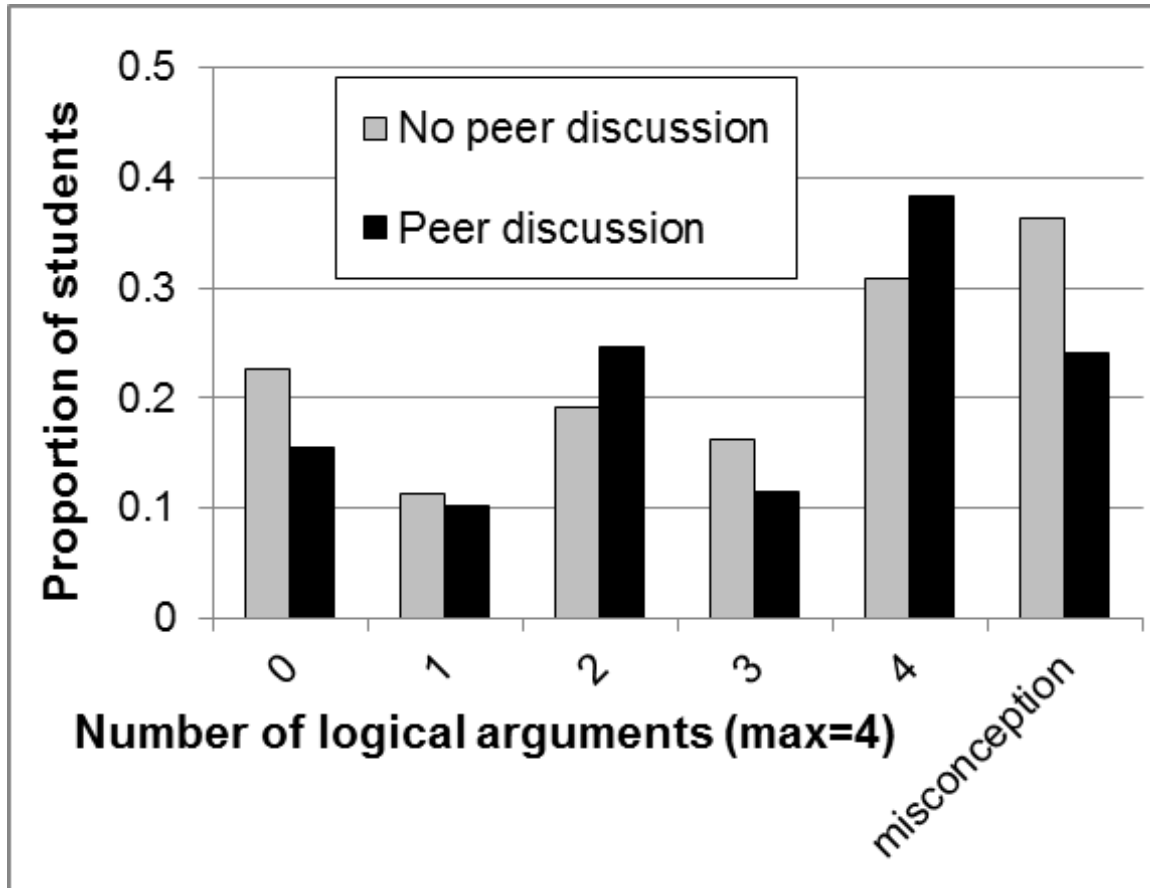
Argument grade: 4/4

“Most of the plant mass comes from the air. Plants use the CO₂ obtained from the atmosphere to generate sugars produced through the Krebs’s cycle. These sugars are then used for the plant to metabolize and grow by photorespiration.”

Argument grade: 3/4 (+ fundamental misconception)

Results:

Students who engaged in peer discussion prior to writing their explanation had a significantly higher number of arguments (generalized linear model for binomial data: $p = 0.013$) and fewer misconceptions (GLM: $p = 0.01$) in their written explanations compared to the no peer discussion group.



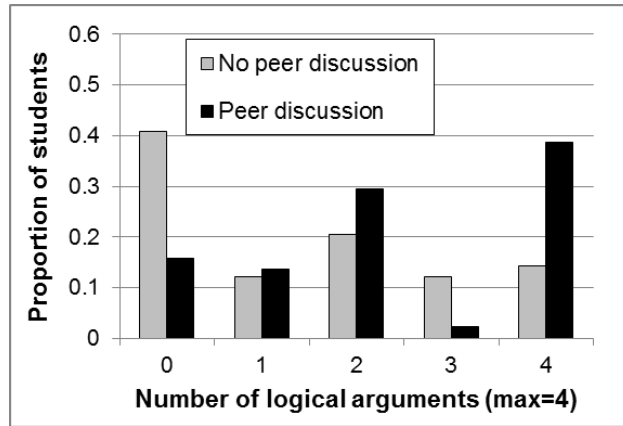
No peer discussion: $n = 204$

Peer discussion: $n = 175$

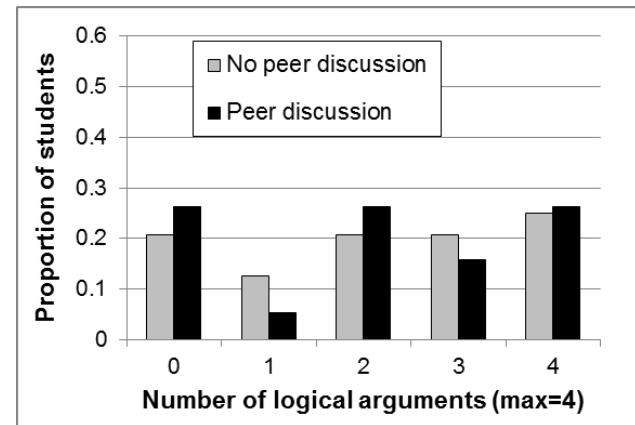
Results:

Students in the lowest grade quartile (based on midterm grades) benefitted most from peer discussion (GLM: Quartile 1: $p < 0.001$, Quartiles 2 and 3: $p > 0.05$, Quartile 4: $p = 0.04$)

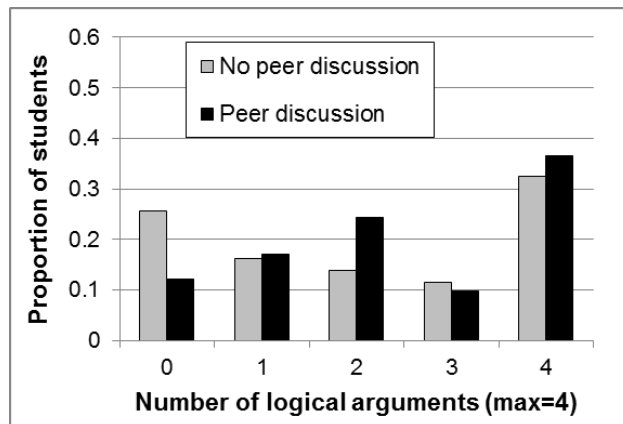
Quartile 1 (33.7-68.2% on midterm 1)



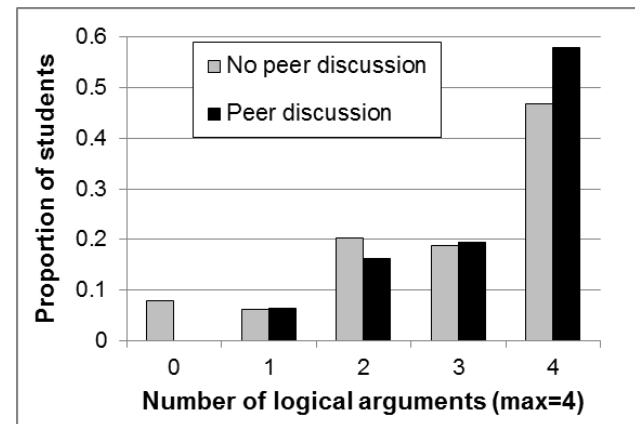
Quartile 2 (68.2-77.2% on midterm 1)



Quartile 3 (77.2-84.5% on midterm 1)



Quartile 4 (84.5-100% on midterm 1)



Conclusions and Future Directions:

- Students who engage in peer discussion prior to providing logical explanations construct more complete answers and have a lower incidence of misconceptions
- Peer discussion is most useful for the development of logical arguments for students in the lowest grade quartile
- Future objectives are to analyze more student explanations for different questions and to track student progress over time.

Questions or comments?

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