Examining Student Peer-to-Peer Questions During Collaborative Activity

Soren Miller[1] and James Nyachwaya[2]
[1]St. Olaf College [2]North Dakota State University

Introduction

"The evidence that good teaching has taken place is reflected more in the kinds of questions students ask than the abundance of 'pat' answers they can produce"

~ Carner, 1963, p.550

- Questioning is central in scientific inquiry.[1, 2]
- Question-asking is one of the eight 'science and engineering' practices in the NGSS.[3]
- Question-asking contributes to meaningful learning.[4]
- Social Metacognition is a valuable awareness and evaluation of the thinking of others in the group.[5]

Research Goals

- Characterize students' peer-to-peer questions
- Uncover trends in peer-to-peer questioning
- Identify the functions and roles of student questions

Prompt Provided

During a lab activity on acids and bases, students were reacting sodium hydroxide solution and dilute hydrochloric acid. Students were instructed to add the base to the acid till the base was in excess. The progress of the reaction was monitored by measuring the amount of current conducted by the reaction mixture as sodium hydroxide was added to the acid.

a. Write a balanced equation for the acid-base reaction.

b. Write a net ionic equation for the neutralization reaction.

c. (i). Suppose you were measuring electrical conductivity of the reacting mixture as the base was added to the acid, predict how conductivity would change. (ii). Provide an explanation for your prediction.

d. Sketch a graph illustrating your prediction in 'c' above, clearly labelling the axes and indicating the end-point.

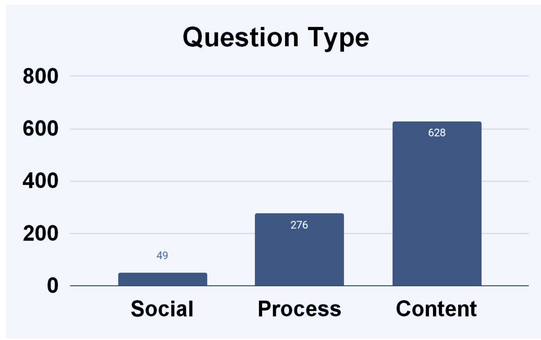
e. Explain why you drew the graph as you did in 'd'.

Methods

- General chemistry (II) class, *N*= 265
- Students worked in groups of 2-4
- Audio and written data were collected
- Audio data was transcribed
- Questions were coded for type and role
  - Type: social, process, content
  - Role: information seeking, confirmation seeking, eliciting ideas, seeking consensus, challenging another's idea, conversation starting, and **Social Metacognition**
  - Social Metacognition questions were then subcategorized into the following:
    - Monitor: Statements to monitor group understanding
    - Evaluate: An assessment of the groups thinking

Results

- 959 Total questions asked from 63 groups
- Groups on average asked 15 questions
- Groups asked a range of 2-44 questions
- Of the 63 groups, 53 had all group members ask at least one question
- No group had more than 1 person not ask a question
  - 4 Groups of 2 had only 1 participant ask questions
  - 4 Groups of 3 had only 2 participants ask questions
  - 2 Group of 4 had only 3 participants ask questions
- Upon further analysis, 61.8% of all confirmation questions were student stated ideas in the form of a question



Example of a Social Question

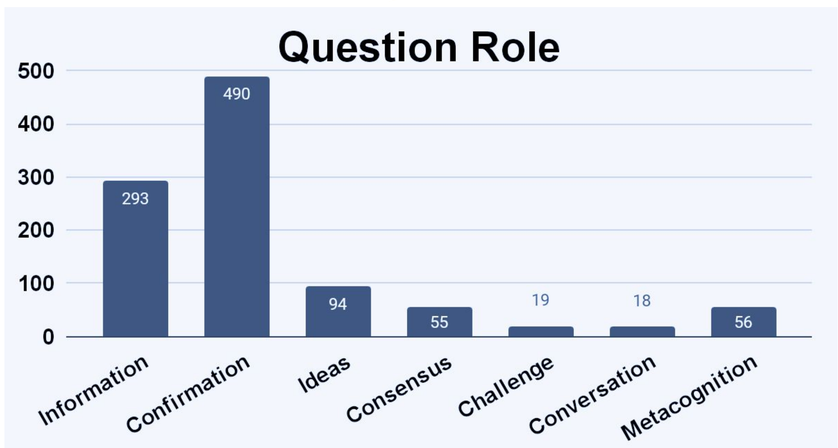
"What's up?"

Example of a Process Question

"Yeah okay I think that makes sense, where do we have to turn that in?"

Example of a Content Question

"Would that be HCl?"



Student Response Comparison Between Social Metacognition and Confirmation Questions

Example of Confirmation Question

*"So wouldn't that become H_2O and NaCl **right?"***

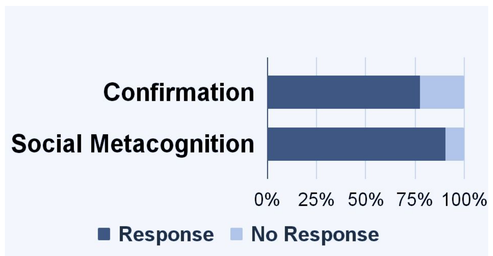
"Yes, yeah it should."

Example of Social Metacognition

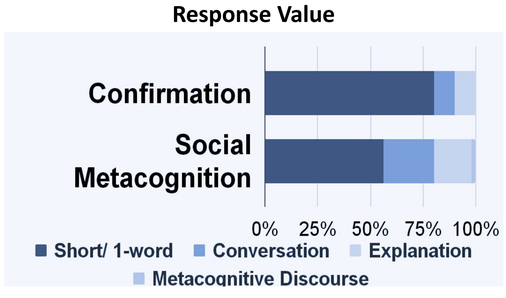
"That's what we did. ***OK, do we think that's right?"***

"I think so."

Response Rate

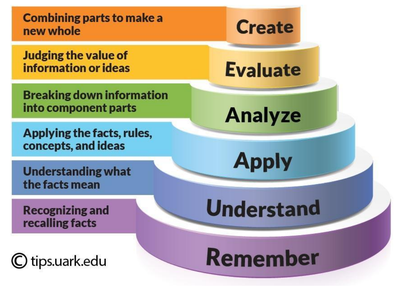


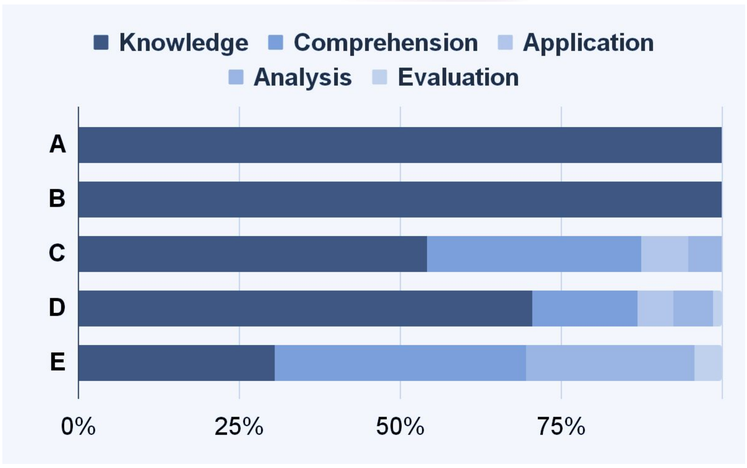
Response Value



Material based on work supported by NSF DUE 1852045. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of NSF.

Bloom's Analysis of Questions Elicited





Discussion

- Most student questions were content based, but only served to seek information and confirmation
- Students did not ask many social metacognition questions, but when they did the responses were more valuable
- Most prompts elicited only lower level Bloom responses
- Prompts that asked for an "explanation" demonstrated slightly higher order language use

Implications

- Students are able to ask higher order content based questions, but social metacognitive skills need to be explicitly taught
- Having students explain their thinking and reasoning in a group leads to higher order discussions
- Collaborative time in class is essential for building these question asking skills

References

[1]Chin C. and Brown, D. E. *International Journal of Science Education.* 2002. 24(5), 521-549

[2]Ming Lai and Nancy Law. *Instructional Science.* 2013. 41, 597-620.

[3]NGSS Lead States (2013), Next Generation Science Standards: For States by States, Washington DC. The National Academies Press.

[4]Chin C. and Osborne. *J. Stud. Science Education*. 2008. 44(1), 1-31.

[5]Stephanine Halmo, Emily Bremers, Samantha Fuller, Julie Dangremond. *Life Science Education.* 2022. 21(58), 1-20.

Image credit to Jessica Shabatura. Image obtained from https://tips.uark.edu/using-blooms-taxonomy/ (last accessed July 10, 2023).