# Characterizing Student Interactions During a Collaborative Activity

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## Introduction

- Benefits of Collaborative Learning
  - Development of joint understanding of concepts and building knowledge (Becker et al., 2013; Osborne, 2010)
  - Impact student understanding (Warfa et al., 2018)
  - Lead to development of higher order thinking (Spencer and Moog, 2008)
- "Communicating in written or spoken form is another fundamental practice of science; it requires scientists to describe observations precisely, clarify their thinking, and justify their arguments." (National Research Council, 2012)
- Communicative Approaches (Mortimer and Scott, 2003)
  - Interactive Dialogic
  - Non-interactive Dialogic
  - Interactive Authoritative
  - Non-interactive Authoritative

## Research Questions

1. What is the nature of the questions asked and feedback provided between group members?
2. What is the nature of students' interactions in their groups?

## Methods: Context

- Data came from a general chemistry (I) class in the spring semester of 2020 (Pre-COVID)
- Students were in groups of 2 to 4 with 46 total group recordings
- Focus on concept of precipecipate and reactions of aqueous solutions
- Students were shown a 12 second video of precipitation
- Students were assigned a set of questions to respond to based on the reaction in the video
- Students were asked to write their answers down and also record their conversations

## Activity Questions

1. Watch the 12-second video in the link below. In the space below, describe what you observed.
2. Based on the ions in the two solutions, what are the formulas of the compounds in each solution?
3. Based on the formulas you determined above, predict the products and write a complete molecular equation of the reaction.
4. Write a complete ionic equation for the reaction.
5. Write the net ionic equation.
6. Suppose we initially measure the conductivity of one of the solutions, and then slowly add the second solution to it, how would you expect the conductivity of the mixture to change? Assume you have equal amounts of solution.
7. (a) In the space below, sketch a graph of current conducted against amount of solution 2 added.
   (b) Explain your sketch.

## Methods: Data Analysis

- We adapted the communicative approaches methodology (Mortimer and Scott, 2003) as a lens to look at classroom interactions
- Examined the nature of questions asked in groups and the types of feedback students gave each other
- Analysis relied on 'episodes' (Hollabaugh, 1995), with each episode capturing conversations between students
- Episode boundaries were determined by a shift in what was discussed, e.g. reading instructions for the next question

## Results: Questions and Feedback

| Type of Question | Instances |
|---|---|
| **Confirmatory** - "And it just goes up, right?" | 393 - 58.6 |
| **Clarification** - "do you mean like we balance it?" "No?" | 146 - 21.8% |
| **Surface Level** - "What's Pb?" "What's this, what's ionic equation mean?" | 67 - 10% |
| **Probing** - "Can you explain how we do that?" | 52 - 7.7% |
| **Guiding** - "So what are we thinking we made?" | 13 - 1.9% |

| Type of Feedback | Instances |
|---|---|
| **Confirmatory** - "Yep" "Yep, perfect" "I don't know" "No" | 295 - 76% |
| **Clarification** - "No, we just did that." "Because then that would be 2" | 61 - 15.7% |
| **Surface Level / Explanation** - "That's lead. NO3 is nitrate" "So we have to, uh, see which one, what the precipitate was in the situation, so… so um, we have to figure out which one of these would form a precipitate." | 32 - 8.2% |

## Results: Communicative Approaches

**Interactive Dialogic - 27 Groups**

S1: Complete ionic equation for the reaction. Oh wait
S2: Did I already do that?
S1: Predict the products, oh, write the complete thing.
S2: So then write that and then the sign
S1: No, so these are, it's this and then the yields of this
S2: Oh, ok.
S1: So that's a plus sign
S2: Oh, gotcha. Yeah, I see.
S1: Ooo.
S2: So do I
S1: So yeah, just the way it switches.
S2: Ok.
S2: Oh, yeah, that looks like something way more nice, that makes more sense ok.

**Non-Interactive Dialogic - 8 Groups**

S1: So, we just saw two… a reaction between two different mixtures, and they reacted.
S2: Yeah. It was Pb 2 plus and NO3 minus reacting with K plus and I minus.
S1: When they reacted, they, on the outside, they didn't mix, but then when they came together, the on… only the parts that like touched mixed, and they didn't go through with like all of the other parts that was in the little dish.
S2: Hold on. Hold on.
S1: So the formulas that we came up with for this would be lead nitrate and potassium iodide.
S2: And we predicted that the products would be lead iodide and potassium nitrate. It's PbI2 and 2KNO3.

**Interactive Authoritative - 6 Groups**

S2: Are you supposed to have that 2 there, because then there not
S1: This is the same as his. I am going to erase it. I think you're right. Ok, I think that looks right.
S2: yeah,
S1: ok
S2: Suppose we initially measure the conductivity
S1: Oh, maybe this is 2,
S2: No,
S1: No?
S2: Because then that would be 2
S1: Oh, that's just the charge, nevermind, yeah (cut off Student 2 in previous statement)
S2: yeah

**Non-Interactive Authoritative - 5 Groups**

S2: Do we say that it's a change in color or did a precipitate form?
S1: Uh… I don't know, I'd say it's tough telling from just a video.
S2: It's...
S1: I'm just gonna say it's a change in color,
S2: Just a change in color kind of? [said simultaneously with 1 above]
S1: yeah. I don't know.
S2: Do you think a precipitate formed or?
S1: I don't think so.

## Discussion

- There was a leader in almost all groups who seemed to direct conversations
- The most common interactive approach was interactive dialogic
- Most of the questions asked in groups were confirmatory
- Most of the feedback provided was simply confirmatory
- There were cases where questions were asked, but ignored

## Conclusions and Implications

- Students do not know how to engage in group discourse
  - Need to be taught how to
    - Communicate
    - Learn
    - And interact in groups
- Need to explicitly teach students
  - the classroom norms
  - the group norms
  - how to formulate questions

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