Talking Through It

Using Student-to-Student Interviews and Brainstorming Activities for Facilitating Critical Inquiry

Krista Schmidt· Western Carolina University· kschmidt@wcu.edu

Background

Undergraduate physical chemistry students are tasked with designing and conducting an experiment based on a prompt provided by their professor.

Prompts are based on fundamental physical chemistry concepts and are meant to build on students' understanding of chemistry as a whole. Students work together in pairs of two or threes.

Prompt Examples
Determine the:
Gibbs Free Energy of a Chemical Reaction
Velocity of a Gas Molecule
Enthalpy of Vaporization of a Volatile Liquid
Enthalpy of Combustion for a Reaction

At Issue

A rush to search; no strategy. Multiple searches, few on-point results.

Random keyword searches, not well organized.

Underutilizing established knowledge from previous courses; require heavy prompting regarding existing knowledge.

Groups not consulting internally before searching; not maximizing knowledge and skills.

Inequality within student pair dynamics.

Sources restricted to non-textbook, non-laboratory sources.

Initial Approach

- Create short list of guided questions to prompt thinking
- Interview one another using guided questions
- Interviewer records answers
- Mixed pairs/groups
- Time limits

Researcher Name: Interviewer:
Project: Date:

1. Can you please describe the basic concept(s) of your project?
2. How would you explain these concepts in other ways? For example, if you had to explain what your experiment is about to your mom or dad, what would you say? How would you describe it to them?
3. What don't you know at this point (besides exactly how you are going to perform this experiment)? What's unclear?
4. What keywords or key phrases do you think you'll use for searching for information?
5. What databases, books, electronic resources, journals do you plan on using for your research?
6. Can you think of ways to expand your project to show a trend or make comparisons to different systems (rather than simply stating one value as your conclusion)?

Second Iteration

- Added question about existing knowledge
- Added written examples of answers, refined specificity of questions
- Cut resource questions
- Separated keyword searching into discrete exercise; formalize idea exchange between interviewee and interviewer

Researcher Name: Interviewer:

1. What is your project?
2. What do you know already about your objective? *For example, if you were tasked to determine the molecular weight of a polymer, you might say you know that most molecular weights are measured using X method or that polymers are made up of monomers or that polymers have a high molecular weight.*
3. What do you think are the two or three main concepts of your objective?
4. How would you explain these concepts in other ways? For example, if you had to explain what your experiment is about to your mom or dad, what would you say? How would you describe it to them?
5. What ideas or concepts do you think you are going to need a little more help understanding? Besides exactly how you are going to perform this experiment, what is still unclear to you?
6. Can you think of ways to expand your project to show a trend or make comparisons to different systems (rather than simply stating one value as your conclusion)?

Name:

1. Write your research statement or question here (in a full sentence). (1 minute)
2. Brainstorm and list synonyms and terms related to your topic. (2 minutes).
3. Pair up with a neighbor, exchange sheets, and allow them to list their search term ideas here (2 minutes)

Final Activity

- Changed words perceived as nebulous by students to concrete, subject-specific terms
- Added measurement/calculation prompts – commonly omitted considerations
- Keyword exercise updated; now prompt for narrower/broader terms, terminology relating to calculations, laws, etc.

Researcher Name: Interviewer:

1. What is your project?
2. What do you know already about the chemistry related to this project? *For example, if you were tasked to determine the molecular weight of a polymer, you might say you know that polymers are made up of monomers or that polymers have a high molecular weight.*
3. Without simply repeating your project title, describe your end goal. For example, finding a specific constant or a particular type of energy, etc. Can this be measured directly? If so, how do you measure it? If not, how will you calculate it?
4. How would you explain this chemistry in other ways? If you had to explain what your experiment is about to your mom or dad, what would you say? How would you describe it to them?
5. What don't you understand about this project (besides your exact experimental methodology)?
6. Can you think of ways to expand your project to show a trend or make comparisons to different systems (rather than simply stating one value as your conclusion)?

Name:

What is your project?

List the two main chemistry concepts related to your experiment in the boxes below.

Also list any laws, equations, or calculations that apply to your experiment.

Concept 1	Concept 2	Laws/Equations/Calculations
Broader Terms	Broader Terms	
Narrower Terms	Narrower Terms	

Trade this sheet with your interviewer.

Outcomes and Observations

Questions as thinking prompts served as refreshers and search starting points.

Interviewees not distracted by writing "correct" or expected answers.

Interviewer occasionally provided additional topic information.

All project members, upon regroup, could contribute; members, professor, librarian then identified areas of topic (un)familiarity.

Some questions too open-ended or vague; students struggled with "What do you mean?" Interviewers had trouble clarifying.

Few clarifications asked when the response was "I do not know." Amount of information collected varied.

Unfamiliarity with resources made source question too difficult.

Outcomes and Observations

Questions about existing knowledge, with examples, equaled more productive interview.

Wording specificity resolved some vagaries and confusion about exact nature of question.

Addition of separate exercise and structured table encouraged critical thinking and served as better reference for search keywords.

Exchanging sheets addressed unequal feedback from interviewers.

Some questions still interpreted as too vague; students struggled to understand question rather than focus on ideas/concepts related to project.

Students often neglected fundamental considerations of project, particularly measurements, calculations, governing laws.

Outcomes and Observations

Increasing specificity of question terminology greatly reduced "What do you mean?" responses.

Forcing students to consider laws and measurements before initial design resulted in better design, more on-point searching strategies. Also pushed existing knowledge to forefront for consideration.

Keyword exercise redesign strategically pushed students to consider specificity of project while prompting recall of related chemistry concepts.

Specificity in interview and keyword exercise resulted in easier identification of actual inquiry problems. For example, do both group and individuals have thorough grasp of chemistry related to project? Are search keywords appropriate for each category?