The challenge of listening: 
An individual student interview about current flow

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The challenge

As researchers and as instructors, we are faced with the daily challenge of listening accurately to our students.

How can we best hear what our students are saying?

The individual student interview

• One-on-one conversation minimizes distractions and interruptions.
• Recording is easy; there is plenty of time.
• An open-ended “think-aloud” format allows the student to direct the discussion.

In many ways, an ideal listening device.

Sample interview task

Designed to explore student reasoning about the conducting properties of materials.

Steel rod

“What happens in the steel rod when you connect it to the leads of the battery?”

Answers consistent with accepted physics:

- CLASSICAL
  “Free electrons” in the metal are pushed by the electric field created by the battery.

- QUANTUM
  Delocalized electrons move within or between “conduction bands.”

Next:
Excerpt from interview with “Sarah”

Question to consider:

How is this interview going so far? Is it going well?

Beginning of Sarah interview (page 1 of 3)

I: So here is the set-up … battery, your average battery pack, we’ve got two leads, and let’s see that I took a piece of stainless steel, and I placed the stainless steel into the circuit; I made a circuit out of it, right? So attach one end, attach the other end … what happens when you attach both ends?
S: The circuit loop is complete, so current or electrons will flow out and around back in.
I: Okay. What's going on specifically inside of this piece right here? [indicates steel rod]
S: Electrons are also flowing through that, depending on the makeup of this. I don’t know, assuming just … steel, you said… conducting material. I don’t know if that’s what you… complete conductor, semi-conductor. Do you want me to explain in more detail…?
I: Yeah, sure… go into as much detail as you can. Feel free to make any type of drawings along the way that might help you in your explanation.
Excerpt from Sarah interview  (page 2 of 3)
S: Okay. I don’t know exactly what happens in a resistor, but current is slowed down. It slows down…well, I would assume that there’s some kind of chemical property, well I don’t know if it’s a chemical property, but the oscillating electrons, maybe they’re not oscillating as much…
I: What do you mean by oscillating electrons?
S: Well, that goes back to the first pretest and how the electrons move around the wire. I think the electrons are oscillating, slowly moving around.
I: Okay, so…moving around the circuit?
S: Yeah, that’s right. Whatever.
I: […] How are they oscillating? Around what? Can you give me more detail?
S: Mmm…not much! I wouldn’t know if they were…well, oscillating perpendicular to the flow or parallel… I don’t know, are they oscillating at all?

Excerpt from Sarah interview  (page 3 of 3)
S: Well, all these things have uh, these are different chemicals, and they’re each going to have their different electrons and protons, so when the electron moves through, maybe there’s the attraction and repulsion between this structure, where they’re all positive and negative electrons… that’s stuff I’ve never thought about before, and I’m just making it up as we go along!
I: Well, okay! See, that’s not bad…after all there’s… it’s how you come to making it up that’s interesting also.

Excerpt from interview with “Sarah”
How is this interview going so far?
Is it going well?
On what basis do you judge it to be going well (or poorly)?

My initial answers
How is the interview going so far?
It’s trash. There’s hardly any data here.
If I were analyzing it later, I’d skip this part.
On what basis do I judge it to be going poorly?
We aren’t learning much about how she thinks conduction works. The electrons just “move around the loop.” She offers little sense of physical mechanism.
She refers to “oscillation,” but it’s not clear why anything is oscillating, or what that has to do with current flow.

What do my answers tell us?
My initial answers tell us about my interests.
I am automatically interested in student conceptual knowledge of physical mechanism.
There are other interests one might have (or cultivate).

Possible interests
1. Conceptual knowledge of physical mechanism
   Does the student know the correct physics? Does she have a particular alternative model?
2. Source of knowledge
   Is the student’s knowledge memorized, constructed, experienced with the senses, other?
3. Knowledge construction
   Is the student skilled at it? How does she generate and select among ideas?
4. Beliefs about knowledge
   What epistemological thinking is in evidence?
1. Conceptual knowledge of physical mechanism

Does the student know the correct physics? Does she have a particular alternative model?

- Little or no data is shown in the excerpt.

My automatic interest

2. Source of knowledge

Is the student’s knowledge memorized, constructed, experienced with the senses, other?

- There is quite a bit of data.

Another valid interest

3. Learning to listen

- I was not explicitly aware of my research interests.
- Despite my lack of awareness (or because of it!), my interests acted as a “filter” on the data.
  - I didn’t hear the student’s "source of knowledge" statements the first time.
- Now that I think about other possible agendas, I am quite interested in them.

Learning to listen

4. Clues to interviewer’s interests

- "What do you mean by oscillating electrons? How are they oscillating? Around what?"
- Perhaps he shares my automatic interest in physical mechanism.
- "It’s how you come to making it up that’s interesting also."
- Perhaps he has epistemological interests.

Clues to interviewer’s interests

5. Researchers and teachers

Researchers must consciously narrow their focus in order to publish.

Researchers and teachers
Researchers and teachers

Researchers must *consciously narrow* their focus in order to publish.

Teachers must *consciously broaden* their focus in order to teach effectively.

The challenge of listening

- **Listening accurately to students requires careful effort.**
  
  We do not automatically hear everything a student says.

- **Some statements are blocked by the “filter” of our own interests.**
  
  Our interests may be implicit or explicit.

- **Explicit consideration of our “filters” increases our repertoire for teaching and research.**