



The Content and the *Conversation*

**Formatively Assessing Oral
Scientific Argumentation**

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The *Next Generation Science Standards* (NGSS) call for students to engage in Argument from Evidence (Practice 7, NGSS Lead States 2013). Accordingly, both written and oral argumentation are playing larger roles in helping students make sense of complex science ideas. Well-timed, meaningful feedback can support students' capacity with this essential science practice. However, oral arguments are challenging to assess in real time. They are fast moving and require complex multitasking from teachers as they listen to the content of the arguments presented and help students to maintain cordial conversational norms (Sampson, Enderle, and Walker 2012). Formative assessment and just-in-time supports, then, should attend to both the arguments presented as well as students' engagement in the social practice of argumentation itself. In this column, we map out these two dimensions of oral scientific argumentation. We also present a framework aimed at bringing these dimensions—the content of arguments presented and the social practice of scientific argumentation—into focus.

Two dimensions at play during oral scientific argumentation

Imagine a hypothetical class discussion led by students. Perhaps it goes something like this: After considering claims and evidence independently, students are ready to share their ideas. One student identifies the claim they think is most convincing and provides supportive evidence. Another student draws on a relevant science idea to explain how the evidence connects to the claim. Next, a third student enters the conversation, interrupting with a point that is unrelated to the argument at hand, sparking a side conversation.

How do you provide formative feedback to this group? It might be tempting to apply the same assessment criteria for written arguments to oral exchanges like this. For example, *are individual students making claims? Is the content each student shared accurate?* However, oral scientific argumentation is more than a single argument. Rather, it encompasses both the intrapersonal (the arguments students pose) and

FIGURE 1: Rubric for formatively assessing oral scientific argumentation.

Intrapersonal	Claims	Evidence	Reasoning	Relevance
	Students offer claims [tentative answers] to address questions under discussion.	Students use evidence to support their ideas.	Students use reasoning to explain how data serve as evidence for their claim[s] and/or explicitly connect multiple pieces of evidence.	Students' contributions are relevant to the scientific question that is the focus of the argumentation activity.
Interpersonal	Listening	Critiquing	Co-Constructing	Regulation
	Students reference the contributions of others and/or ask one another to clarify or elaborate their positions. Students indicate listening through their body language.	Students offer helpful critiques for arguments made by others.	Students construct or refine their thinking in ways that build on what others have to say.	Students manage the discussion in such a way that respectful, equitable, and productive discourse can occur.

the interpersonal (how they work together as a group to move their thinking forward). Much of this will be missed if formative assessment focuses solely on the content-related contributions of each individual.

Formatively assessing the intra- and interpersonal

Informed by existing research (see “Ideas That Guide Our Formative Assessment Framework” in box) as well as emergent findings from an NSF-funded study (Henderson et al. 2021) that allowed us to partner directly with teachers in their classrooms, we identified eight components of oral scientific ar-

gumentation. Four of these components focus on the content of arguments shared (intrapersonal) and four focus on the group’s engagement in the conversation (interpersonal).

The intrapersonal dimension includes claims, evidence, reasoning, and relevance. The interpersonal dimension includes the social aspects of scientific argumentation critical to the conversation itself: listening, critiquing, co-constructing, and regulation. Through classroom observations and conversations with teachers, we developed and revised descriptive statements about what students might do or say as they demonstrate each of these components.

To enable quick scoring of these distinct aspects

FIGURE 2: Tips for recognizing and supporting intrapersonal aspects of oral argumentation.

	Recognizing What you might hear students say when making a claim	Supporting Useful teacher prompts
Claims	<ul style="list-style-type: none"> • I believe that _____. • I think that _____. • I predict that _____. • My claim is _____. • One idea I have is _____. 	<ul style="list-style-type: none"> • Is someone willing to share what they think? • We have just discussed . . . evidence. What claim or claims does this seem to support? • Does someone think something else? • What question do we still need to answer?
Evidence	<ul style="list-style-type: none"> • The data we collected suggests that _____. • The evidence says that _____. • I observed that _____. 	<ul style="list-style-type: none"> • What might be some evidence or data that supports what you think? • What could you use to support your ideas? • What observations support your ideas?
Reasoning	<ul style="list-style-type: none"> • The evidence supports what I said because _____. • How it happens is that _____. • The evidence matters more/less because _____. 	<ul style="list-style-type: none"> • How does your evidence support what you think? • How are different pieces of evidence connected to one another?
Relevance	<ul style="list-style-type: none"> • How is that related to your question? • Can you connect that idea to your question? • Are we digressing here? Let’s remember that the topic/issue is _____. • Are we getting off-topic? How does this relate to _____? 	<ul style="list-style-type: none"> • Students making use of their readings, evidence sources, etc., during discussion.



of oral argumentation in real time, we developed a formative assessment rubric (see the rubric for formatively assessing oral scientific argumentation in Figure 1). The rubric asks the scorer to consider how well the statement describes what they are see-

ing or hearing during a discussion. Aligned with the collaborative process of scientific argumentation, this rubric is designed to formatively assess the components at the group—rather than the individual—level; that is, instead of entering scores

Ideas That Guide Our Formative Assessment Framework

Key idea	Source
Oral arguments consist of both the content voiced by students (<i>argument</i>) and the back and forth process of building ideas (<i>argumentation</i>). This distinction allows for two bundles of components: the intrapersonal, which deals with the argument itself, and the interpersonal, which deals with the process of argumentation.	Osborne, Erduran, and Simon 2004
Participants in oral argumentation are accountable to facts and logic, which means that a valid argument is both scientifically accurate and relevant to the question at hand. In addition, participants are also accountable to the learning community, which means a valid argument takes into account the contributions of others.	Michaels, O’Conner, and Resnick 2008
Opportunities for collaborative discourse can act as a scaffold for developing argumentative reasoning. The social interactions that take place between students are essential for this development. This idea elevates the important link between the intra- and interpersonal dimensions.	Kuhn and Udell 2003

for each participant, the scorer enters scores for an entire discussion group.

The description of a hypothetical classroom discussion at the beginning of this article highlights how the rubric can support formative assessment that encompasses both the intra- and interpersonal dimensions. Feedback that addresses the intrapersonal aspects of claim, evidence, and reasoning attends only to the argument presented. However, it is clear that there is much more happening during this exchange. Referencing the rubric widens the formative assessment lens to encompass the interpersonal dimension, bringing aspects such as co-constructing and regulation into focus. Tips for

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FIGURE 3: Tips for recognizing and supporting interpersonal aspects of oral argumentation.

	Recognizing What you might hear students say when making a claim	Supporting Useful teacher prompts
Listening	<ul style="list-style-type: none"> • So, what you are saying is _____. • What do you mean when you say _____? • I didn't fully understand. Can you say that again? • I don't think that is what they meant. I think what they meant was _____. 	<ul style="list-style-type: none"> • In your own words, can you rephrase what was just said? • Can someone repeat the argument that was just made? • What are your thoughts about the idea that _____ just gave us?
Critiquing	<ul style="list-style-type: none"> • I understand what you are saying, but _____? • If that was true, then wouldn't _____? • Have you thought about _____? • I see it in a different way. I think that _____. 	<ul style="list-style-type: none"> • Can anyone challenge the ideas offered? • Does anyone have another way of seeing this? • Do any of you disagree? • Why do you disagree?
Co-constructing	<ul style="list-style-type: none"> • Building on what _____ said, _____. • Kind of like what _____ said, _____. • Our group thought that _____. • I disagree with what _____ said because _____. • Earlier, people were talking about _____ and I think that _____. • Now that you said that, it makes me wonder _____? 	<ul style="list-style-type: none"> • Is there a way that we can combine these ideas? • How does that relate to what others said?
Regulation	<ul style="list-style-type: none"> • I'd like to hear what _____ has to say about _____. • Do we agree enough to move on? • I think we are stuck. Should we talk about a new piece of evidence, or does someone have a different idea? • Let's let other people talk and see if there are any new ideas. 	<ul style="list-style-type: none"> • I'm hearing a lot of good ideas, but they are only coming from a few people. How can you support one another to ensure that everyone feels comfortable talking? • How are you working well as a group and how could you improve to make sure all ideas are considered and strengthened? • How can we respond to one another's ideas and not just add our own separate ideas?

noticing and providing tailored support for each aspect of argumentation are provided in Figures 2 and 3.

Our teacher partners noted how using the rubric helped them listen more carefully and notice aspects of the conversation that had gone unnoticed before. For instance, one teacher shared the following reflection: “Over time, my whole focus shifted . . . I started [asking] how are they thinking? How are they reasoning? How are they working with each other? I am able to see where students were successful [during the discussion], because I know about things like critiquing or co-constructing.”

Other teachers also noted a shift in focus from the contributions of individual students to the complex exchanges that were happening between students.

Getting started

You can use the rubric whenever students engage in evidence-based discussion in pairs, groups, or as a class. You do not need to formatively assess all eight components of oral argumentation at once. In fact, many teachers we worked with chose to focus on one intrapersonal and one interpersonal component each time they assessed their students.

If you prefer to enter scores digitally, you can access an online version of the rubric (see Online Resources for link to the DiALoG homepage). When you follow the link, you can access the scoring rubric by choosing “Start.” This digital rubric was developed in collaboration with focal teachers and field tested in 44 classrooms across the country as part of our larger NSF-funded study. The digital version of the rubric allows you to record notes, see tips, and view a report. In addition, the digital version provides Responsive Mini-Lessons (RMLs) that target each component and are suggested based on the scores you enter.

Conclusion

Evidence-based scientific discussions can provide windows not only into students’ science content understanding but also into how students are working together as a learning community to advance their scientific thinking. Providing opportunities to engage in oral argumentation can help students build capacity with this essential and authentic science practice. The framework and rubric offered here provide guidance for attending to both the intra- and interpersonal aspects of oral scientific argumentation in a systematic way. •

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ONLINE RESOURCE

DiALoG homepage—<https://learning.amplify.com/dialogtool>

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