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Learning Through Talk and Argument

In order to process, make sense of, and learn from their ideas, observations, and experiences, students must talk about them. Talk, in general, is an important and integral part of learning, and students should have regular opportunities to talk through their ideas, collectively, in all subject areas. Talk forces students to think about and articulate their ideas. Talk can also provide an impetus for students to reflect on what they do—and do not—understand. This is why many seasoned teachers commonly ask students to describe terms, concepts, and observations in their own words.

Two additional ways to think about talk in learning have specific applications in science. First, the language of science can be very particular. Certain words have precise, specialized definitions. It is quite common, however, for children and adults alike to confuse specialized science definitions with the more familiar definitions commonly associated with those words. An example of this, as mentioned earlier, relates to the word "theory," which in science is understood to mean "a well-elaborated body of scientific knowledge that explains a large group of phenomena." In common parlance, the word "theory" is often used to refer to a guess or a hunch. By having students read and discuss instances in which different definitions of a word are used and then explain how they've come to understand it, teachers can help students distinguish between science-specific and more common meanings of a word. Another form of talk that has unique applications in science is argumentation. Like the language of science, it too needs to be distinguished from nonscientific interpretations in both definition and practice.

Argumentation can take several different forms. It is important that educators and students recognize and understand the science-specific forms of argumentation and how they differ from the common forms of argumentation in which people engage in daily life. For example, the kinds of arguments in which a person may participate with family members, friends, or acquaintances are often acrimonious or focused on the desire to make one's point and "win" the argument. Or in the case of more formal debate, such as the kind politicians engage in, contestants are scored on their ability to "sell" and argument that favors a particular position.

Both of these forms of argumentation differ from scientific argumentation in important ways. In science, the goals of argumentation are to promote as much understanding of a situation as possible and to persuade colleagues of the validity of a specific idea. Rather than trying to win an argument, as people often do in nonscience contexts, scientific argumentation is ideally about sharing, processing, and learning about ideas.

Scientific argumentation is also governed by shared norms of participation. Scientific argumentation focuses on ideas, and any resulting criticism targets those ideas and observations, not the individuals who express them. Scientists understand that, ultimately, building scientific knowledge requires building theories that incorporate the largest number of valid observations possible. Thus, while scientists may strongly defend a particular theory, when presented with a persuasive claim that does not support their position, they know they must try to integrate it into their thinking.

Encouraging Talk and Argument in the Classroom

In spite of the importance of talk and argument in science and in the learning process in general, K-8 science classrooms are typically not rich with opportunities for students to engage in these more productive forms of communication. Analysis of typical classroom practice suggests that patterns of discourse in classrooms typically adhere to a turn-taking format, often characterized as "recitation." A teacher asks a question with a known answer and a student is called on and responds. The teacher then follows up with a comment that evaluates the student's response.

This talk format is sometimes referred to as the I-R-E sequence, for teacher *I*nitiation, student *R*esponse, and teacher *E*valuation. Researchers have found it to be the dominant, or at least the default, pattern of discourse in classrooms. As such, students come to expect and accept it, and after a few years of using the I-R-E sequence, it's often difficult to get them to use a different pattern.

While I-R-E recitation can be helpful in reviewing prior knowledge or assessing what students know, it does not work well to support complex reasoning, to elicit claims with evidence, to get students to justify or debate a point, or to offer a novel interpretation. I-R-E patterns are likely to support only some of the strands of science learning (e.g., Strand 1) but not others (Strands 2-4). The I-R-E discourse pattern is not a particularly good one if the goal is to encourage and support argumentation. But changing long-standing discourse patterns in the classroom is not a simple undertaking. Students and teachers will require extensive modeling and ongoing support to become comfortable and competent with more effective talk formats.

The kind of discourse that encourages scientific talk and argument is different—in subtle and not so subtle ways—from the I-R-E pattern of discourse. To begin with, teachers ask questions that do not have "right" or "wrong" answers or to which they themselves don't know the answers. For example, a teacher might ask, "What outcome do you predict?" and follow up the initial question with comments such as, "Say more about that." They may ask other students to respond, saying, "Does anyone agree or disagree with what Janine just said?" or "Does anyone want to add or build on the idea Jamal is developing?"

Teachers may also ask students to use visual representations, such as posters or charts, to make their thinking more accessible to the rest of the class. They may follow questions with "thinking" or "wait" time, so that students have a chance to develop more complex ideas and so that a greater number of students have a chance to contribute, not just those who raise their hands first.

Teacher-initiated questions might also ask for clarification, for example, "Does anyone think they understand Sarah's idea? Can you put it into your own words?" They might pose alternate examples or theories, or "revoice" a student's contribution, saying, for example, "Let me see if I've got your idea right. Are you saying that our measurements will be less accurate with shoes on?" This strategy helps make the student's idea, restated by the teacher, more understandable to the rest of the class. These "talk-moves" implicitly communicate that it takes effort, time, and patience to explicate one's reasoning and that building arguments with evidence is challenging intellectual work.

The table on the next page shows six productive classroom talk moves and examples of each, which teachers can use to help students clarify and expand their reasoning and arguments. These talk moves are illustrated throughout this book in the different case studies.

Talk Move	Example
Revoicing	"So let me see if I've got your thinking right. You're saying ________?" (with space for student to follow up)
Asking students to restate someone else's reasoning	"Can you repeat what he just said in your own words?"
Asking students to apply their own reasoning to someone else's reasoning	"Do you agree or disagree and why?"
Prompting students for further participation	"Would someone like to add on?"
Asking students to explicate their reasoning	"Why do you think that?" or "What evidence helped you arrive at that answer?" or "Say more about that."
Using wait time	"Take your time. . . . We'll wait."

In addition to talk moves, teachers can engage students in a number of talk formats, each of which has a particular norm for participation and taking turns. Examples include partner talk, whole-group discussion, student presentations, and small-group work. A number of studies have suggested that productive classroom talk has many benefits in the classroom. It can lead to a deeper engagement with the content under discussion, eliciting surprisingly complex and subject matter-specific reasoning by students who might not ordinarily be considered academically successful.

Some of the reasons why productive classroom talk is so important, and why it may be effective, include the following:

- It allows students' prior ideas to surface, which in turn helps the teacher assess their understanding.
- Discourse formats such as extended-group discussion might play a part in helping students improve their ability to build scientific arguments and reason logically.

- Allowing students to talk about their thinking gives them more opportunities to reflect on, participate in, and build on scientific thinking.
- It may make students more aware of discrepancies between their own thinking and that of others (including the scientific community)
- It provides a context in which students can develop mature scientific reasoning.
- It may provide motivation by enabling students to become affiliated with their peers' claims and positions.