Conceptualizing Talk Moves as Tools: Professional Development Approaches for Academically Productive Discussions

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It is now widely accepted that certain kinds of well-structured talk, whether teacher guided or student directed, promote academic learning. Productive classroom talk—in all subject areas, at all grade levels—has been recognized by major U.S. teaching organizations (e.g., the National Council of Teachers of Mathematics, the National Council of Teachers of English, the National Science Teachers Association), and all major National Research Council consensus documents, and finds explicit support in the Common Core and Next Generation Science Standards. All of the chapters in this volume, each in its own way, reinforce and extend this claim.

But simply knowing that productive talk is important, and encouraging or mandating that teachers engage their students in evidence-based discussion and argument, is not enough to ensure that it happens. For many years, researchers and teacher educators have tackled the challenge of helping teachers at all stages develop skills in facilitating discussion so that it is the students who do the heavy lifting in terms of explaining, justifying claims with evidence, and critiquing and improving ideas in concert with peers. We have learned a great deal about effective professional development for teachers on productive discussion over the past two decades (Ball & Forzani, 2011; Beck, McKeown, Sandora, Kucan, & Worthy, 1996; Boaler, Ball, & Even, 2003; Chapin, O'Connor, & Anderson, 2009; Gillies, 2004; Hiebert, Gallimore, & Stigler, 2002; Kucan, 2009; Loucks-Horsley, Hewson, Love, & Stiles, 2003; McKeown & Beck, 2004; Mercer & Littleton, 2007; Roth, 2007; Stigler & Hiebert, 2009). There are a great many books on the market about how to teach with discussions, within various subject areas, and for different grade bands.

In spite of the research knowledge, and the many and varied efforts at professional development, the dominant form of teacher-led group talk is still recitation. (Recitation is sometimes referred to as IRE, where the teacher initiates a question, a student responds briefly, and the teacher evaluates the student contribution as correct or incorrect.) Reasoning and evidence-based discussion typically are not happening in mainstream classrooms. Even focused professional development efforts by well-organized and skillful researchers often result in only modest changes—teachers move away from recitation to some extent or for a while but do not consistently take on the more deeply transformative routines and practices

associated with robust discussion (Alvermann & Hayes, 1989; Alvermann, O'Brien, & Dillon, 1990; Billings & Fitzgerald, 2002; Kucan, 2009).

As anyone knows who has tried to lead an academically productive discussion (whether with pre-K students or participants in a graduate seminar), it is not simple. There are many challenges in getting students to go public with their ideas so others can hear and understand them, and getting students to listen carefully and respectfully to the ideas of their peers. There are challenges in getting students to dig deeper into their own reasoning with evidence and models, and to build on and critique the reasoning of others, so that the group members make progress together in building and weighing academic arguments.

This is not surprising, considering the complexity of the activity. Orchestrating academically productive discussion—that is, discussion that supports robust learning for each student—involves a multidimensional blend of human interaction mediated by language, often about a complex topic, with an ambitious goal of human learning. It involves social, cultural, psychological, and cognitive dimensions, all within the context of an academic domain. Many people have the opinion that although a few amazing teachers may figure out how to do it, it cannot be done on a large scale.

This chapter explores our attempts to help teachers develop their skill at orchestrating productive talk. We conceptualize talk moves as useful *tools* that help teachers respond to specific challenges they face in facilitating discussions. We describe how this approach addresses persistent problems in professional development, and we explore some of the principles behind this approach. Finally, we discuss two programs in which this approach is being tried with teachers in two different subject areas, and we report some preliminary findings.

Our Previous Attempts: Talk Moves and Limitations

Our work has centered on what we have called *talk moves*. These are simple families of conversational moves intended to accomplish local goals. For example, the "say more" family of talk moves (*Can you say more? Say that again. Can you give us an example?*) is intended to encourage students to elaborate on condensed, cryptic, or inexplicit utterances. The "press for reasoning" moves (*Why do you think that? What s your evidence? What led you to that conclusion?*) are intended to get the student to explicate his or her reasoning so the teacher gains a better sense of the student's understanding and all students can work with it. In the process of responding, of course, the student also gains metacognitive and communicative skills that will support more robust reasoning in future turns.

These moves, also known as *talk tools,* are an outcome of two decades of qualitative classroom-based research on how some teachers skillfully orchestrate equitable and productive discussion (Godfrey & O'Connor, 1995; O'Connor, 1996; O'Connor, 2001; O'Connor & Michaels, 1993, 1996). The teachers we observed were able to routinely create and sustain productive discussions (in a range of content areas and across a range of grade levels) with a diverse group of students, including English learners, students on IEPs (Individual Education Plans), and students who had struggled in the past and were school-averse. In some cases, classrooms included students living in poverty alongside privileged students from

professional families. These teachers were able to create classroom cultures of respect and risk-taking so that all students might feel safe to go public with their ideas, take up the ideas of their peers, argue productively, and make progress in reasoning through challenging academic problems. In some cases their students, documented in a number of small-scale studies, made remarkable gains on standardized tests (Chapin & O'Connor, 2012; Dudley-Marling & Michaels, 2012).

Our framework has its roots in sociological, linguistic, and anthropological approaches to classroom research going back over 30 years—in particular, Sinclair and Coulthard's (1975) work on a recurring pattern of teacher-student interaction and Mehan's extension of it (1979). Sinclair and Coulthard identified the traditional discourse-move sequence of IRF (initiation-response-feedback), which Mehan renamed IRE (initiation-response-evaluation) in his work documenting the teaching of Cazden. Mehan and Cazden emphasized the tripartite structure, especially the role of evaluation, and investigated extended thematic segments made up of IRE sequences.

Many have explored the pedagogical implications of this pervasive discourse pattern, often explicitly in the service of expanding opportunities granted to students from linguistically and culturally divergent backgrounds (e.g., Cazden, 2001; Wells, 1999). Close study of the IRE/IRF sequence has been and still is warranted: Recent research has demonstrated that it continues to account for over two-thirds of teacher talk in most classrooms (Nystrand, 1997).

Through documenting talk in the studied classrooms, we identified a set of recurring moves that seemed to take the conversation from recitation to reasoning, opening up the conversation, helping students listen carefully to one another, and supporting them as they built on and critiqued the ideas and arguments of their peers. We catalogued and analyzed these moves for their linguistic and interactional value, and we began to talk about them as *productive talk moves*. This distinguished them from many other moves that are common in classroom talk, such as the evaluation move in the IRE sequence, or a teacher's simple repetition of what a student has said, which often has an implicit evaluative force. We found evaluation moves and simple repetitions in all classrooms we studied; but in these particular classrooms, they were outnumbered by other kinds of utterances. Our observations of teachers and the work of other researchers have led us to believe that any teacher who succeeds in supporting productive discussion must rely on some set of talk moves—ways of eliciting and responding, commenting, and inviting responses (Alvermann et al., 1990; Berland & Reiser, 2009; Ford & Forman, 2006; Kim, Anderson, Miller, Jeong, & Swim, 2011; McKeown & Beck, 2004; Osborne, Erduran, & Simon, 2004; Saunders & Goldenberg, 2007; Wells, 2007).

As we further developed this work on talk moves, we began the process of creating professional development materials, in collaboration with Lauren Resnick and colleagues (Michaels, O'Connor, Hall, & Resnick, 2002). This project was part of Resnick's work with the University of Pittsburgh's Institute for Learning; it features Accountable Talk as one of nine Principles of Learning that underlie its approach to broad-based school reform. We have continued to work on these talk moves with colleagues in English language arts, math, and science education (Chapin et al., 2009; Dudley-Marling & Michaels, 2012; Michaels, O'Connor, & Resnick, 2008).

Why Focus on the Utterance?

To some, it may seem unwise to focus on the level of the utterance. Our focus on talk moves may be reminiscent of a simple script—a potentially mindless routine that teachers can follow without thinking about the content. Rather, one might argue, we should start with the *content* of the utterance. For example, is the teacher asking a *known-answer question* or an *open question* (where the teacher does not know the answer)? Why start with the utterance, or more specifically, at the talk-move level?

We focus on the utterance for both theoretical and pragmatic reasons. Along with many others, we assume that utterance types have interactional, identity-related, and cognitive or intellectual consequences (Ford & Forman, 2006; Haroutunian-Gordon, 2009; Mayer, 2012; Sfard, 2008; Wells, 2007). Thus, when we look at teacher or student utterances in classrooms, we note:

- An utterance has a particular interactional function, both local and global, in terms of its positioning of the previous and the next speaker and in terms of the structure of the conversation overall.
- An utterance may have a particular socializing or intellectual function, such as helping students to externalize their thinking, listen to others, dig deeper into their reasoning with evidence, or reason with the ideas of others.
- An utterance positions specific academic content and makes certain reasoning experiences available.
- An utterance has a particular linguistic form, which may have major consequences for the functions listed above.

Because of the semiotic potential of the utterance, it makes sense to attend to it. But these are theoretical observations. Practically speaking, the work of teaching is complex, and the moment-to-moment orchestration of talk is challenging (often described with metaphors of spinning multiple plates or juggling). But an utterance-level tool, a talk move, can be easy to remember and easy to pull out with a bit of practice. A whole set of tools can fit on a clipboard for reference during discussions. Moreover, these moves change the nature of the talk that transpires between teacher and students and among students. These talk moves work by positioning students differently than is typical in most lessons. They are thus powerful context- and people-transforming moves.

Practical Challenges and a Reconceptualization

Teachers' responses to our presentation of talk moves have sometimes been deflating. Some say, "Oh, I already do that," "I tried that and it didn't work," or "I don't like that move, it just doesn't feel right to me."

We came to realize that we did not yet know how to present these tools *as tools*. We began to draw more systematically on the sociocultural and sociohistorical work on tools as *mediational means:*

1. Tools are designed to solve problems; they make sense only in light of a problem or purpose and in relation to other tools in the tool kit.
2. To understand a tool, the user needs to know what to use it for within the set of problems it is designed to solve. No tool, not even a hammer, is transparent in its use. Part of what we are learning when we learn how to use a tool skillfully is how to work with the materials that the tool itself acts upon.
3. Some talk moves (like any tools) are easier to pick up and use than others. (Wait Time, the most researched of all talk moves, is a notoriously difficult talk tool to pick up.)[1]
4. Teachers must use tools in strategic sequence. This takes practice, and requires attending to and becoming familiar with the materials that the tool acts upon, as well as understanding the larger problem or purpose.
5. All tools belong to a tool kit that is associated with an identity. If we ask teachers to take on a new set of tools, in a sense we are asking them to take on a new identity that embodies particular values and beliefs.

These understandings about tool use illuminate some of the weaknesses in our attempts to convey these tools to teachers. First, we had assumed that a description of academically productive discussion in general terms would be sufficient to convey the purposes of each talk tool. Second, we had assumed that the linkages between particular micro-situations in a discussion and the use of certain talk moves would be obvious. Third, we had assumed that the main set of obstacles would be content-related. We were wrong in each assumption.

Obstacles to Discussion, Leading to a Focus on Key Goals

We have found that teachers experience a number of daunting obstacles when trying to use discussion. The first includes the problem noted in most studies of the paucity of discussion in classrooms: the perceived *pressures of time* introduced by pacing guides and assessment goals. The second obstacle includes fears about the *content* of discussion: Teachers sometimes fear that they will not be able to identify topics or questions that will lead to productive discussion.

Another main obstacle teachers have identified for us is their concern about *interactional issues*: (a) the fear that students will not respond or participate at all; (b) the fear that during discussion, students will engage in open or covert conflictual behavior; (c) the fear that only a few academically able students (or perhaps those from privileged backgrounds where the cultural capital of discussion is available in the home) will participate; and (d) the fear that English language learners or students with disabilities will feel unduly stressed or pressured by being asked to speak in front of the group.

Hearing about these obstacles helped us sharpen our picture of the enterprise and gave us some purchase in our attempt to describe the talk moves as tools. (Recall that tools make sense only in light of a problem or purpose, and that in order to understand a tool, you need to know what to use it for within the set of problems it is designed to solve.) We built

Four Goals for Productive Discussions

To facilitate substantive and rigorous discussions, the following four goals are necessary and foundational. Without these, you will not have the conditions you need to ensure that the talk deepens student reasoning and understanding. The talk moves described in this section will help you accomplish these four goals.

- **Goal 1: Helping Individual Students Share Their Own Thoughts**
  If a student is going to participate in the discussion, he or she has to be able to share thoughts and responses out loud, in a way that is at least partially understandable to others. If only one or two students can do this, you don't have a discussion—you have a monologue or, at best, a dialogue between the teacher and a student.
- **Goal 2: Helping Students Orient to and Listen Carefully to One Another**
  If a student is just sitting waiting to speak, and is not *listening* to others and *trying to understand them*, he or she will not be able to contribute to a real discussion. Your ultimate goal involves sharing of ideas and reasoning, *not* simply a series of students giving their own, unconnected thoughts, one by one.
- **Goal 3: Helping Students Deepen Their Reasoning**
  Even if students express their thoughts and listen to others' ideas, the discussion can still fail to be academically productive if it does not include solid and sustained reasoning. Most students are not skilled at pushing to deepen their own reasoning. Therefore, a key role of the teacher is to continuously and skillfully press the students for reasoning and evidence.
- **Goal 4: Helping Students Engage With Others' Reasoning**
  The final step involves students actually taking up the ideas and reasoning of other students and responding to them. This is when real discussion can take off, discussion that will support robust learning. And it's exhilarating for students and teachers alike!

Figure 1. These goals for facilitating classroom discussion are adapted from Anderson, Chapin, & O'Connor (2011). Copyright 2011 by Math Solutions. Adapted with permission.

sets of foundational *goals:* obvious but important requirements that underlie any academically productive discussion. We call them goals because they must be set and planned for; achieving them takes consistent work.

One set of goals relates to *classroom norms for discussion*. It is critical to establish norms of respect and equity, so students feel their ideas will be taken seriously and they can work through their own reasoning without fear of derogation or ridicule. (Due to space considerations we will not discuss these norms here; for more information see Chapin et al., 2009, 2013, or Michaels et al., 2008.)

Another set of goals concerns the interactional arena where *student contributions* take place. We can introduce the talk moves as tools that will help teachers accomplish these goals. Figure 1 lays out essential goals for productive student discussions as defined by Anderson, Chapin, and O'Connor (2011).

We know that these four goals, obvious as they may be, make sense to teachers and reflect their classroom realities. We frequently encounter teachers who say, "I can't get to Goal 1 because my students won't say anything!" Others say, "My students love to talk, they just won't listen to one another!" Others say, "I can get to Goal 1 and Goal 2, but the talk is boring and superficial. Students won't really dig into their own reasoning and try to figure

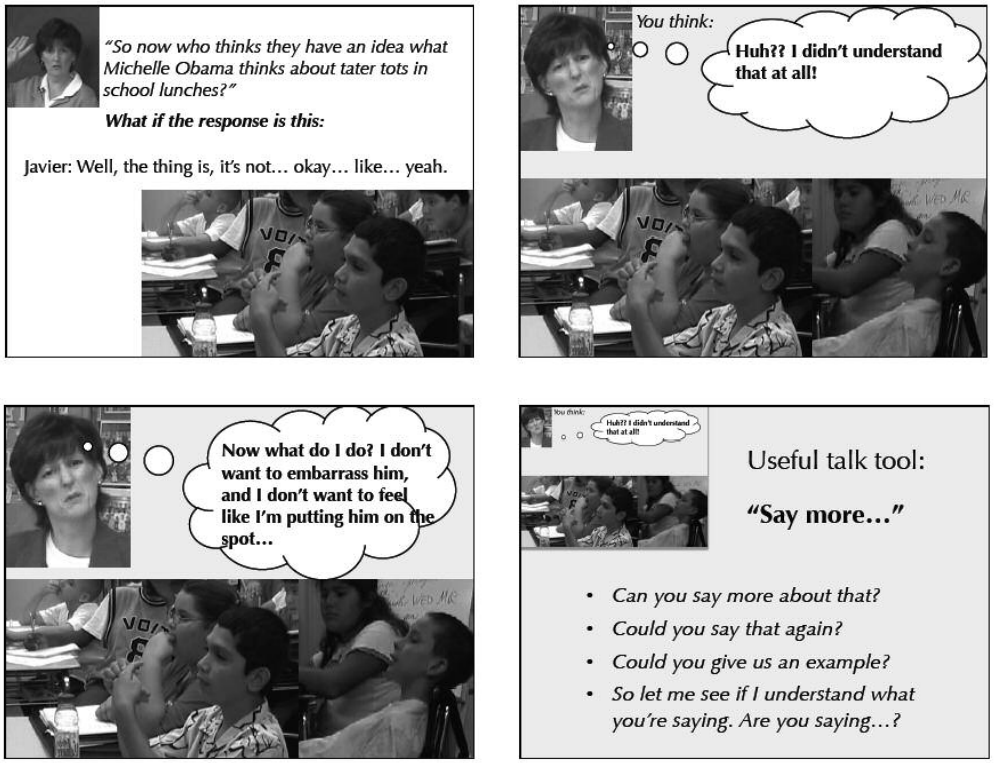

Figure 2. Four slides about one discussion situation: "Huh?"

things out at a deeper level." In a few classrooms, teachers will say they can reach Goals 1, 2, and 3, but their students are simply "sharing out" their reasoning in their own mental space, not in interaction with others' ideas.

Relating Talk Tools to Goals and Fears

Once the goals are set out, it is possible to portray classroom situations in terms that make reference to the goals. And simultaneously, as teachers envision achieving the goals, they also envision the unnerving unpredictability of interaction.

For example, Figure 2 illustrates one of our professional development techniques for teachers who were using a discussion-based curriculum. Through a sequence of slides we showed scenarios in which a teacher deals sequentially with student responses. With each new response type, we introduced a new set of tools to deal with that type of response problem. The example in Figure 2 concerns a common but underdiscussed problem: A teacher asks a question and a student attempts to answer, but the answer is unintelligible. This is an unavoidable part of orchestrating discussion, but many teachers find it among the most daunting of obstacles.

Vehicles for Jointly Introducing Goals, Obstacles, and Tools

These techniques can be effective in face-to-face professional development, in a one-to-many presentation with discussion. But how do we provide scalable resources—materials and tools that are easily accessible and useful to teachers with coaches, or in professional learning communities and study groups on a wide scale? Moreover, how do we make language visible and object-like, so teachers can begin to see these talk moves as tools (like a hammer or chisel), and pick them up and use them? How do we support professional development on talk at scale, given the inevitable improvisational nature of classroom discussion, and its variability in light of different content, grade levels, and purposes?

Here we will briefly describe two professional development (PD) resources that we have participated in constructing. Both attempt to provide supports for the four goals that underlie discussion, as well as the goals concerning classroom discussion norms, while attending to the obstacles and fears that accompany early attempts to run discussion. Both also deal with teachers' concerns about content and the nature of the tasks or questions they will need in order to begin or sustain productive discussion. These resources apply to two specific content areas or curriculum domains: mathematics in Grades K–6 and physical science in Grades 3–5.

The first, *Classroom Discussions in Mathematics*, includes a book with classroom videos by Chapin et al. (2009) and a facilitator's resource with five hours of video by Anderson et al. (2011). Both are built around the question, "What do we talk about?" They identify discussion topics for (a) mathematical concepts, (b) computational procedures, (c) solution methods and problem-solving strategies, (d) terms, definitions and symbols, and (e) mathematical reasoning. Examples of each are provided for different grade levels and exemplified in classroom videos of discussion. The book can be used as a core text for a study group, and the facilitator's guide provides support for watching and discussing the video clips. At the heart of the book, and exemplified in both short and long video clips, are the four goals for productive discussion and the set of productive talk moves described above.

The guide provides suggestions for establishing video-viewing norms, sequenced discussion questions, and blackline masters for each study group session. The video clips contain subtitles but no voice-over introductions or commentary. For this reason, it is recommended that a live facilitator help teachers interpret the videos, see how they exemplify the ideas in the book, and explore how the examples might be relevant to each teacher's own context. The program provides examples of each talk move in different classrooms, dealing with different content and grade levels. This helps teachers see that the talk moves are both variable and consistent.

Our second PD resource, the Talk Science Project,[2] takes a different approach to the challenge of content, topic, framing questions, talk as tool, and facilitation. Talk Science is a web-based, open-source PD site with video and text resources, designed for study groups without facilitation. The materials are linked to the Inquiry Project's "Matter" curriculum for Grades 3–5, so the content and topics of discussion are predetermined and clearly specified. The curriculum is designed as a learning progression over three years, helping students build an understanding of matter (e.g., that the physical quantities of weight, volume, and

density are interrelated and that solids, liquids, and gases are distinct forms of matter). It focuses on evidence-based reasoning practices through investigation and discussion, with framing questions built into the teacher's guide for each lesson.

The full curriculum is available on the web, including a downloadable teacher's guide with numerous live links to video, printable student science notebooks, formative assessment probes, and text materials to support teachers' understanding of the core science at issue and the challenges of orchestrating productive discussions. But merely building in time for discussions (as we have seen in other efforts) does not ensure that they will happen. To support teachers in enacting these discussions, a web-based professional learning pathway (modeled on the Rosetta Stone language learning program) guides participants to engage with videos and to participate in study-group discussions with colleagues. The pathway provides overview information, through a set of video cases, on what productive talk looks and sounds like, how talk promotes learning, and how to establish classroom norms of respect and equity. Teachers can also review a video case that introduces them to nine productive talk moves, linked to the four goals described above. Downloadable text materials also accompany, and amplify, these video cases.

Once they begin teaching the Inquiry Curriculum, the pathway guides teachers to explore the four goals and nine productive talk moves in more depth. In a guided sequence, they explore a set of classroom cases that illustrate the talk moves in context (timed to be viewed right before they teach the same lessons). They also view engaging interviews with scientists working through the very activities and investigations that the students are about to engage in. Taken together, the PD resources and pathway are designed to help teachers deepen their understanding of the science they are teaching, and to provide just-in-time support on how to facilitate productive "make meaning" discussions about daily hands-on science investigations. Talk Science PD is thus a blend of web-based study, face-to-face study group meetings, and opportunities to try out ideas in the classroom in the context of specific lessons. One strength as well as one disadvantage of the Talk Science resources, compared to the math discussion materials, is that they are designed around a particular curriculum and a particular grade band. While they are only relevant for teachers using that curriculum, for those teachers, they provide specific guidance.[3]

Is There Evidence That These PD Programs Work?

Both of these PD programs, Classroom Discussions in Math and Talk Science, are new. The facilitator's guide, *Classroom Discussions: Seeing Math Discourse in Action,* was published in 2011. And while some evidence shows that the materials are well received, as yet there has been no systematic research on the use of the materials in study groups.

Talk Science, however, was funded by NSF as a research and development effort in its Discovery Research K–12 program, from 2010 to 2013. It was designed with an ongoing research component to document the impact of the PD (and the curriculum with which it is aligned) on teachers' understanding of productive talk and their facility in orchestrating it with students. The Talk Science web-based suite of tools for Grade 4 was developed in the fall of 2010 and piloted in unfinished form in the spring of 2011, by 12 teachers of Grade 4

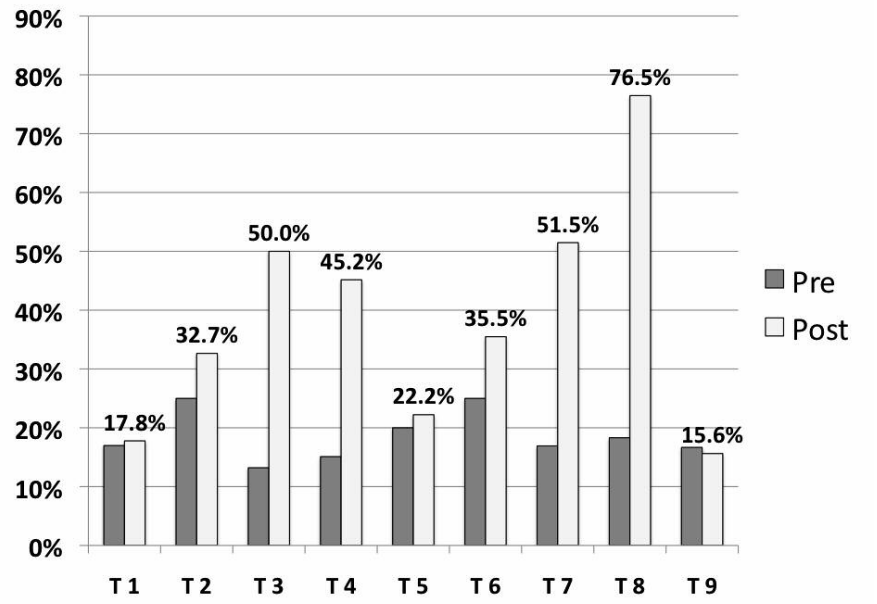

Figure 3. Comparing nine teachers on their use of academically productive talk moves, before and after the Talk Science intervention. The changes are shown as percentages of total teacher turns (to control for length of discussions). T = teacher.

in five schools (urban, suburban, and rural, in Massachusetts and Vermont). The web-based tools for Grade 5 were completed in the fall of 2012 and piloted with 12 teachers of Grade 5 (at the same schools). Thus, 24 teachers in five schools have piloted the Inquiry Curriculum and Talk Science Professional Pathway and have participated in study groups during the implementation of the curriculum.[4] We collected extensive talk-related data with these 24 teachers:

1. Pre- and post-intervention 15-minute audio recordings of classroom discussions (transcripts of discussions of concept cartoons and video of lessons)
2. Audio recordings of all teacher study groups
3. Pre- and post-intervention science content interviews
4. Pre- and post-intervention talk interviews (focused on teachers' understanding and practice regarding classroom talk)

A full report of the research and coding manuals are available at the Inquiry Project website (http://inquiryproject.terc.edu). Here, we want to discuss only a limited part of the research, to suggest that we have preliminary evidence that the approach—conceptualizing talk moves as tools—can help teachers begin to take up these tools and use them in reasoning-based discussions. This preliminary finding is perhaps not surprising, but it is positive: The video-based PD on talk moves does seem to help teachers begin to use productive talk moves.

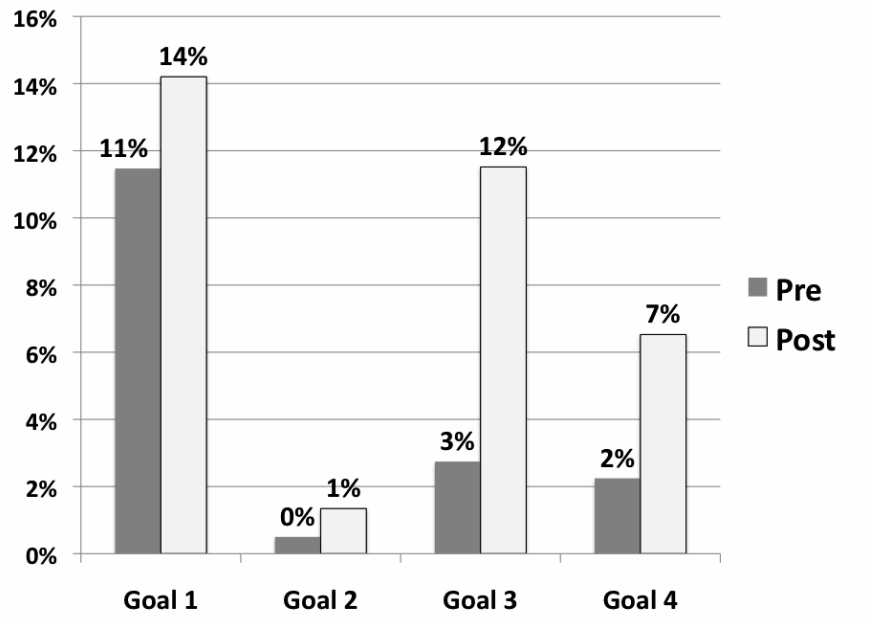

Figure 4. Comparing nine teachers' use of talk moves that supported different goals, before and after the Talk Science intervention, shown as mean changes in frequency of talk moves per teacher turn. Goal 1 = helping individual students share their own thoughts; Goal 2 = helping students orient to and listen carefully to one another; Goal 3 = helping students deepen their reasoning; Goal 4 = helping students engage with others' reasoning.

From our Grade 4 research, we have complete pre- and post-intervention discussions (based on a concept cartoon, eliciting student ideas about volume) for 9 of the 12 participating teachers. Figure 3 shows the differences in the number of academically productive talk moves as percentages of total teacher turns. The difference in talk moves per turn for these nine teachers in the pre-intervention discussion compared to the post-intervention discussion is significant ($t[8] = 2.89$, $p = .02$, 2-tailed). The effect size is large (Cohen's $d = 1.6$).

We also found that not all talk moves were taken up by the teachers equally (see Figure 4). From pre-intervention to post-intervention, the teachers made the largest gains with talk moves that supported Goals 3 and 4 (pressing for reasoning and thinking with others). Of the four categories, only these two showed a statistically significant change (for Goal 3, $t[8] = 3.80$, $p = .0005$, 2-tailed; for Goal 4, $t[8] = 2.73$, $p = .025$, 2-tailed). While teachers made gains with talk moves supporting Goal 1 (sharing, expanding, clarifying one's own ideas), many were already using these talk moves at the outset, so the change from pre- to post- was not as dramatic. However, the talk move family that is intended to support Goal 2 (getting students to orient to and listen to one another) was not used nearly as much as other pre- or post-moves.

This presents an interesting puzzle. The move *Who can put that idea in their own words?* can have a powerful effect on students in building a culture of listening, where students take each other seriously as thinkers and contributors to the group's efforts. Perhaps more

than any other particular talk move, the *Who can repeat or rephrase?* move helps teachers manage the *intelligibility* of the talk—a critical challenge in the noisy and complex linguistic environments of most classrooms. And yet we find this is the least used of all the talk moves (in our own research and as evidenced in the transcripts of other researchers), perhaps because it is not often used in adult conversation and carries with it problematic positioning for some teachers and some students. Thus we find ourselves at a point where we must return to the kind of qualitative work with teachers and students that we began over 20 years ago.

From our preliminary research, one last finding is of note. We studied two teachers in depth, as well as the student talk that went on in their classrooms. We found—again not surprisingly—that even though the video-based PD was successful in getting both teachers to use more productive talk moves, simply opening up the conversation to student thinking was not sufficient to ensure coherence in a discussion. In ongoing research we are exploring this in more detail.

Conclusion

Our work over the past 20 years, watching and learning from exceptional teachers, suggests that particular discursive moves open up a conversation rather than close it down. Through our work and that of others, we can see credible, replicable evidence that well-structured talk in the context of a cognitively demanding task builds the mind. We have suggested that conceptualizing talk moves as tools provides teachers with a useful construct for facilitating academically productive talk.

And yet, if this construct of "talk as tool" is to be used effectively on a large scale, there is more work to do. We still need a better understanding of the mechanisms at work—such as how particular talk moves, or sequences of talk moves, relate to conceptual understanding and learning, motivation to learn, and even changes in students' and teachers' identities.

In our preliminary report of results from the Talk Science Project, we have seen that the simple deployment of talk moves does not ensure coherence in classroom discussions or robust student learning. To improve our PD with talk moves, we need to understand more about how to help teachers know when to use which moves in the service of deep conceptual understanding of core disciplinary ideas and practices. We need to understand better what the most appropriate developmental progression is for teachers in learning about talk tools. Finally, we need to understand better the relationship between teachers' domain-specific knowledge and their use of productive talk moves.

However, we are witnessing important advances in the field and important points of convergence, such as the linkage between research on discussion and research on the Common Core and Next Generation Science Standards. We have an opportunity to build on one another's work, and—as a community of scholars and practitioners in the classroom—to make greater strides in developing usable knowledge, useful tools, and scalable PD approaches, to understand, document, and promote academically productive talk.

Notes

1. In 40 years of work, Mary Budd Rowe found that the only way she ever managed to get teachers consistently to use wait time was to spend 6–10 focused hours of PD on it, and to transcribe 10 minutes of their own talk, three different times! In her final article (Rowe, 1986) summarizing all of this work, she called this kind of PD "aversive."

2. National Science Foundation, DR-K12 Grant (2009-2013): "Talk science! Scalable, web-based professional learning to improve science teaching and learning" (Grant No. 0918435). Sue Doubler (PI) and Harold McMilliams and Sarah Michaels (Co-PIs).

3. Independent of the Matter curriculum, the site provides a library of resources that could serve as a professional learning course of study for any science teachers, at any grade level, who are interested in exploring how to facilitate productive sense-making discussions in science (http://inquiryproject.terc.edu/prof_dev/library.cfm).

4. The teachers' teaching experience ranged from 2 to 24 years, with an average of 13.8 years. They had taught science an average of 10.3 years and had taken an average of 2.6 undergraduate courses in science. Nine teachers had master's degrees.

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