

## Developing Mathematics Students' Critical Language Awareness

This paper is being presented at the 2006 NCTM Research Pre-session in St. Louis, MO as part of a symposium entitled "Connecting Discourse, Teaching, and Curriculum." It is a work in progress so please do not quote from it without first asking my permission.

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The NCTM standards that promote the extension of communication practices in mathematics classrooms expect a new kind of classroom discourse, one that includes more discussion and more ways of talking about mathematics. The resulting changes in classroom discourse have drawn researchers' attention to the language practice in mathematics learning environments.<sup>1</sup> While this scholarship has helped us understand the nature of classroom interaction and the development of mathematical knowledge, I have questions about how this turn of attention to language might make a difference for children in schools.

### Turning Attention to Language

Whether we are talking, listening, reading or writing, when we communicate it is normal to ignore the linguistic details and attend to meaning – attend to the things being talked or written about. Normally the language used in communication is transparent, unnoticed, like a window. We look *through* windows, not *at* windows. When I stand by my kitchen window, for example, I rarely look at the glass and the boundaries of the opening; I look through the opening, through the glass. But at times it is useful to look at the glass and at the boundaries of the opening to become aware of the skewed and limited view of the yard they afford me.

While scholars are learning more and more about the limited and skewed view of mathematics available to students in their language-mediated mathematics classroom, students themselves are typically left using their language as though it is transparent. I suggest that there is value in drawing mathematics students' attention to their classroom language practice so that they can learn some of the lessons learned by the researchers of this language practice.

Though most mathematics teachers already do draw some attention to language from time to time, there are various ways of doing this and a range of reasons. For example, when a teacher tells her class "don't say 'the top', say 'numerator'", she draws attention to language. She is helping her students use conventional terminology but not helping them understand the nature of fractions or their relation to human intentions. Such attention to language (vocabulary building) is necessary because it can equip the children to participate in conversation about the nature of fractions and their relation to human intentions.

Adler (2001), in her account of tensions faced by mathematics teachers (tensions exacerbated in multilingual contexts), coins the expression 'dilemma of transparency' to describe the ongoing need for teachers to decide whether to direct attention to mathematical content or to direct it to the language used to represent the content. Especially in multilingual environments (which are increasingly the norm especially in urban settings), teachers need to help students

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<sup>1</sup> Though change is inevitable with the NCTM's strong promotion of new discourse patterns, studies of reform teaching practice suggest that discourse patterns are resilient to change (e.g. Herbel-Eisenmann, Lubienski, & Id Deen, in press; Spillane & Zeuli, 1999).

express their mathematical ideas in a form that is accessible to others. This kind of attention to language directs students to adopt conventionalities uncritically.

However, there are good reasons for drawing critical attention to language. In their overview of research on mathematics textbooks, Love & Pimm (1996) point out the inherent authority of the text and remind teachers and students that together “their responses to it may range from taking it for granted to seeing their role as challenging and criticizing it (to interrogate and even deconstruct the text)” (p. 380). Morgan (1998), after her own critical discourse analysis of mathematical writing, concludes with a similar call: she suggests that students need to participate in this kind of critical analysis. These encouragements can be extended to suggest that students may be well-served when prompted to look critically at any aspect of their classroom language – oral or written, at the nature of symbols or the nature of human interaction. Neither, Love & Pimm nor Morgan offer means for their suggestion that students become critically aware of the language used in their mathematics. This paper explores how such critical attention might be initiated.

### **Critical Analysis of Discourse**

MacLure (2003) outlines some of the central features of critical analysis that is informed by post-structuralist sensibilities. She notes the need to be engaged in the discourse that one is looking at critically. Students are well-positioned for this because they are already engaged in their mathematics classroom discourse. In this regard, they are positioned better than researchers to analyze their discourse critically. Despite this advantage, critical analysis is far from simple.

Relating to the dilemma of transparency, MacLure also recommends to the critical analyst an approach that on the surface seems to spurn the scientist’s interest in objectivity: “suspend your belief in the innocence of words and the transparency of language as a window on an objectively graspable reality” (p. 12). It is hard to suspend belief. A similar recommendation is to look at language in a new way – to consider it strange. Kress (1990), for example, suggests that we ‘denaturalize’ language practice, that we question the normality of it, so that we can consider alternative practice. With this suggestion he supports my goal for promoting students’ critical awareness of their language practice – to provide them with tools and experience that afford them alternative ways of participating in their classroom discourse. Indeed, without the students’ complicity, discourse reform is a challenge.

For critical analysis, there can be no reified method because choosing a method from outside the situation means ignoring the persons and events in the situation. Thus, the many different approaches to critical analysis of education discourses that have been taken might *inform* further critical analysis, but ought not to be taken as models for replication. Relatively structuralist research of the discourse can also inform post-structuralist, critical analysis. The wide variety of available tools makes it difficult to give advice to educators who would want to raise the critical language awareness of their mathematics students.

In addition to this understandable lack of methodological guidance available for mathematics teachers who want to promote critical language awareness, there are further challenges. School cultures that privilege mathematical prowess may in fact diminish reform practice: tinkering is too risky because of the subject’s importance. Furthermore, the tradition of school mathematics is not inclined toward critical theory.<sup>2</sup>

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<sup>2</sup> By informal observation, it is clear to me that children successful in school mathematics are typically not inclined to critical thinking. However, I cannot say the same thing about mathematicians. Tasić (2001) argues that post-structuralism is closely related to mathematics.

Nevertheless, the possibility of benefit from critical language awareness would seem to beg the question: *How might we prompt mathematics students to become critically aware of their language practice?*

To develop a strategy for this, I reanalyzed some old interview data in which I had played audio tapes to students of their problem solving in groups (Wagner, 2003). From this, I found value in students attending to the discourse generated in their own classroom. This is not to say that there is no value in students analyzing other people's mathematics – deconstructing the textbooks they use, as Love & Pimm (1996) suggest, or analyzing excerpts of discourse from other mathematics classrooms. However, my reanalysis of the interviews suggested to me the importance of students' proximity to the discursive event. With this proximity they have an intimate connection with the human intentions and context of the particular language choices.<sup>3</sup> This connection is supported in linguistic scholarship: even where there is methodological disagreement amongst discourse analysts, there is agreement that an ethnographic component is necessary for valid discourse analysis (e.g. Chouliaraki & Fairclough, 1999 *versus* Stubbs, 1997).

### **Critical Language Awareness in Action**

I offer here a brief account of one attempt to introduce critical language awareness to a senior secondary mathematics classroom. This experience of engagement with the participant students presented frustrating challenges as well as some insight into mathematics teaching and learning. This experiment was only a beginning, set in a unique context with virtually no precedent to draw on. Hopefully others will take up the challenge to prompt students to become critically aware of their language practice in other mathematics classroom settings and with different approaches.

In order to prompt students to ask questions about their discourse, I spent a nineteen-week semester with a Grade 11 academically-inclined mathematics class, co-teaching the course with the regular teacher and collecting video and audio records of classroom discourse. By directing the students' attention to their own utterances, I tried daily to engage the students in discussion about our language practices in the class. The form of my prompts varied, as I was continually responding to the participants (who, in turn, were responding to me). In addition to our classroom interaction about language, I interviewed participant students and asked them to write accounts of their experiences with language in relation to their mathematics learning. I wanted to hear how students described their discourse when they considered it critically.<sup>4</sup>

What follows is a summary of some of the challenges I faced in this engagement and some of the possibilities that became clear to me amidst these challenges.

#### *Challenge #1: What aspects of language might be a good place to start?*

As stated above, there are many ways to analyze mathematics classroom discourse. I chose to begin with a lexico-grammatical approach (which focuses on word-choice and grammatical construction) because I had found the mathematics education scholarship that used this approach to be especially insightful – especially the work of Pimm (1987), Morgan (1998) and Rowland (2000). Furthermore, Fairclough's depiction of *critical discourse analysis*, which

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<sup>3</sup> Though participants in a discourse tend to make their choices of words subconsciously, they are still choices. Discourse analysts commonly draw attention to this choice. Recognizing that there is choice involved in speaking and writing is a strategy for looking at language in a new way, for making it appear strange.

<sup>4</sup> This research is described in greater detail in Wagner (2005).

draws attention to lexico-grammatical features of language, supported my intentions for the participant students, to equip them to find a range of possible ways to participate in their mathematics classroom discourse (cf. Chouliaraki & Fairclough, 1999). Fairclough has promoted the inclusion of such analysis in school curricula, but his encouragement seems to have been taken up only by language educators (Fairclough, 1992). It is not a simple transformation to apply these classroom examples to mathematics classrooms.

I suggest that any approach to the investigation of mathematics learning discourse could be introduced to mathematics students. However, each approach would have its own challenges. For example, if not handled carefully, explicit attention to power relations inherent in Foucauldian analyses (e.g. McBride, 1989, de Freitas, 2004) may undermine the students' sense of security in their classroom. Despite this danger, one could argue that these power relations are the most important thing for children to discuss in their classrooms, and that they need to be more aware of their vulnerable position as students.

*Possibility #1: Drawing on (responding to) scholarship provides a place to start and allows students to feel connections beyond their classroom walls.*

The first time the students in my research responded passionately to my questions about our language practice was in relation to the use of personal pronouns. I showed the class selected written excerpts of their responses to a test question that asked for explanation. Four of these began virtually the same as each other, except for one difference: one was written with an *I*-voice (“I can tell by switching the *y* and the *x*...”), one with a *you*-voice (“You switch the *x* and *y*...”), one with a *we*-voice (“We switch around the *x* & *y*...”) and one with obscured personal agency (“Switch the *y* and the *x*...”), written as an imperative. The students found this difference quite amusing once they noticed the difference. (They did not notice until I circled the pronouns.)

In further discussion that extended over the next three weeks, some of the students argued with each other and with me about the appropriateness of expressing personal voice in mathematics, about the centrality of abstraction (marked by the loss of personal voice), and about the possibility of reading personal voice into generalized expressions that obscure agency. As this discussion focused on a tension central to mathematics (the tension between generalization and human particularity) I have little doubt that it was beneficial to the students. However, in the short span of the semester, I could not find evidence of particular developments of understanding clearly attributable to this discussion except for the development of self-confidence. Perhaps this lack of evidence relates to the kinds of assessment done in the class, which suggests a question about the need for assessing students' sense of what mathematics is. One of the students was quite proud of the fact that he coined a certain kind of grammatical structure the ‘general voice.’ When I told him about Rowland's (2000) analogous ideas about the general sense of the pronoun *you* in mathematics education, it strengthened this boy's sense of pride: he realized that he recognized a phenomenon that ‘important people’ had found significant.<sup>5</sup>

*Challenge #2: When and how might we turn attention to language?*

Though some significant insights emerged from some of our discussions about language in this classroom, I could not identify a pattern that would help define the characteristics of a good language awareness prompt. The use of the students' own writing (in the episode described above) caught the students' attention, but I cannot say why. When I drew attention to the same phenomenon in our oral discourse, the students were even more animated than they were for the

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<sup>5</sup> This conversation about personal pronouns is described in detail elsewhere (Wagner, in press).

discussion about their writing, but I cannot say why. When I asked them to remark on the use of these personal pronouns in their textbook, the students were uninspired, but I cannot say why.<sup>6</sup>

Is it the content of the prompts? The timing of the prompts in the lesson? The context of the lesson? I cannot say. However, with respect to timing it is important to note that it took planning to turn student attention to language. Early in the semester, and for a period in the middle of it, I tried to rely on serendipity for initiating discussion about language: I would plan to teach as usual and turn attention to a language phenomenon when something interesting happened. Reflecting after each lesson in this period, I realized that I was so engaged in the mathematics and the pedagogical relationships that I ignored the medium of the discourse (the language), even though it was my intention to attend to both content and medium. Thus I could not catch “something interesting.” For me, the dilemma of transparency was a challenge when I wanted the attention to language to be oriented to criticism. The difficulty I experienced also gives insight into the students’ resistance to turning their attention away from the mathematics content.

*Possibility #2: Real student engagement depends on them sharing the problem.*

As should be the case in post-structuralist research, my language investigation engagement with the students was relatively unstructured. There were periods of structure but they were frequently altered, often significantly. Though I, as the initiator of this strain of conversation, exercised agency in these structural changes, it is important to note that the students, as always, exercise agency in the classroom: my structural changes were responses to the students’ engagement (or, more often, their lack of engagement). Students also exercised agency in a more proactive way. Some of the students developed their own sense of the value of attending to language. Perhaps they sympathized with my struggle with the problem (or question) I brought into the research. They made the ‘problem’ of communication their own.

For example, in response to my articulation of the challenges and oddity of turning our gaze to the language of the classroom instead of the mathematical content, a pair of students found themselves taking up the problem outside of class time. While pondering the nature of mathematical symbols and their role as a medium for their mathematical thinking, these two friends achieved remarkable insight into the inaccessibility of mathematical objects (insights similar to those noted by various scholars, including Otte, 2001) and the necessity of taking ideas as shared in mathematical conversation.<sup>7</sup> Again, their insight could not be linked clearly to improved mathematical performance. Thus, when assessing students’ ability to communicate their mathematics, it is worth considering the value of assessing their understanding of the challenges inherent in mathematical communication.

*Challenge #3: What does it mean when students are silent?*

Though the developments described above were significant and may paint a rosy picture of critical language awareness, the students in this research usually were either silent or they gave uninspired, shallow answers in response to my questions about language. Though this kind of response was disappointing, it should come as no surprise. First, as noted above, it is a challenge for anyone to attend to content and critical analysis simultaneously. Second, these

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<sup>6</sup> The use of personal pronouns in mathematics textbooks is significant, I argue. I have pursued this significance in collaboration with Beth Herbel-Eisenmann (see Herbel-Eisenmann & Wagner, in review).

<sup>7</sup> This conversation about the way symbols mediate mathematical communication is described in forthcoming work (Wagner, in review).

students were novice language analyzers: it took them time to notice phenomenon that they found significant. Furthermore, some of them claimed to be too shy to share their ideas about language. Third, these students' primary 'problem' was not to understand the mathematics: independent of each other, they all claimed that their real interest was getting good grades so they could be accepted into university programs. Some of them found pleasure in developing understanding, but they maintained that this was of secondary concern.

*Possibility #3: Allowing silence substantiates the significance of students' engagement.*

In the research I describe here, the students were typically silent in response to my prompts relating to their language practice, but they were also typically silent in response to mathematical prompts. By contrast, these participant students were far from silent when talking about their own concerns – in between classes, for example. Because they were typically silent in response to teacher and researcher prompts and vocal about their own concerns, I take their vocal engagement with particular conversations about language as evidence that these conversations related to their personal concerns. I suggest that the students' willingness to be silent when they had nothing to say and to participate animatedly when they did attests to the intimacy and openness of the engagement. The students' honesty also substantiates for us the significance of their insights, and made it clear to each other that their engagement was sincere. These students were representing their own concerns, and thus providing insight into their perspective, which is by nature inaccessible to us.

### **Posing a challenge**

As the students in this research developed their critical language awareness, they were afforded new possibilities for understanding and doing mathematics. They even noted the significance of some phenomena noted by researchers who have investigated mathematics classroom discourse. The research also demonstrated significant challenges for turning attention to critical awareness in mathematics class.

This was one class, in which the conversation began with one approach to language analysis. I want to challenge myself and other educators to find ways of bringing other forms of discourse analysis into the classroom. We might begin with the approaches discussed in this symposium. For example, we might investigate the value of having students discuss, among other things, the location of authority in the classroom and how this authority gets recognized (c.f. Herbel-Eisenmann presentation), the value of variation in student responses (c.f. Choppin presentation), the possibility of students developing pedagogical content knowledge (c.f. Seymour presentation), the nature of alternative discourse patterns and how they might be realized (c.f. Staples presentation), or the way students can inhabit or change roles in mathematical discussion (c.f. Empsom presentation).

### **References**

- Adler, J. (2001). *Teaching mathematics in multilingual classrooms*. Dordrecht: Kluwer.
- Chouliaraki, L. & Fairclough, N. (1999). *Discourse in late modernity: rethinking critical discourse analysis*. Edinburgh: Edinburgh University Press.
- de Freitas, E. (2004). Plotting intersections along the political axis: the interior voice of dissenting mathematics teachers. *Educational Studies in Mathematics*, 55, 259–274.
- Fairclough, N. (1995). *Critical discourse analysis: The critical study of language*. London: Longman.

- Fairclough, N. (Ed.) (1992). *Critical language awareness*. London: Longman.
- Herbel-Eisenmann, B. A., Lubienski, S. T., & Id Deen, L. (in press). Reconsidering the study of mathematics instructional practices: The importance of curricular context in understanding local and global teacher change. *Journal of Mathematics Teacher Education*.
- Herbel-Eisenmann, B. & Wagner, D. (in review). How a textbook might position the mathematics learner.
- Kress, G. (1990). Critical discourse analysis. *Annual Review of Applied Linguistics*, 11, 84-99.
- Love, E. and Pimm, D. (1996). 'This is so': a text on texts. In A. Bishop *et al.* (Eds.). *International handbook of mathematics education: part one* (pp. 371-409). Dordrecht: Kluwer Academic Publishers.
- MacLure, M. (2003). *Discourse in educational and social research*. Buckingham, UK: Open University Press.
- McBride, M. (1989). A Foucauldian analysis of mathematical discourse, *For the Learning of Mathematics*, 9 (1), 40-46.
- Morgan, C. (1998). *Writing mathematically: The discourse of investigation*. London: Falmer.
- Otte, M. (2001). Mathematical epistemology from a semiotic point of view. Paper presented at *The 25th Conference of the International Group for the Psychology of Mathematics Education*, Utrecht, Netherlands. [Internet: <http://www.math.uncc.edu/~sae/>]
- Pimm, D. (1987). *Speaking mathematically: Communication in mathematics classrooms*. London: Routledge & Kegan Paul.
- Rowland, T. (2000). *The pragmatics of mathematics education: Vagueness in mathematical discourse*. London: Falmer.
- Spillane, J. P., & Zeuli, J. S. (1999). Reform and teaching: Exploring patterns of practice in the context of national and state mathematics reforms. *Educational Evaluation and Policy Analysis*, 2(1), 1-27.
- Stubbs, M. (1997). Whorf's children: critical comments on critical discourse analysis (CDA). In A. Ryan and A. Wray (Eds.) *Evolving models of language: Papers from the annual Meeting of the British Association for Applied Linguistics held at the University of Wales, Swansea, September 1996*, 100-116.
- Tasić, V. (2001). *Mathematics and the roots of postmodern thought*. Oxford: Oxford University Press.
- Wagner, D. (2003). Students and teachers listening to themselves: Language awareness in the mathematics classroom. In N. Pateman, B. Dougherty and J. Zilliox (Eds.), *Proceedings of the 27<sup>th</sup> Conference of the International Group for the Psychology of Mathematics Education held jointly with the 25<sup>th</sup> Conference of PME-NA*, Honolulu, Hawaii, vol. IV, 355-362.
- Wagner, D. (2005). Silence and voice in the mathematics classroom, *Canadian Mathematics Education Study Group Conference* (proceedings in press), Ottawa, Canada.
- Wagner, D. (in press). Students' critical awareness of voice and agency in mathematics classroom discourse, *Mathematical Thinking and Learning*.
- Wagner, D. (in review). Facing the mathematics: students' critical awareness of the elusiveness of mathematical objects.